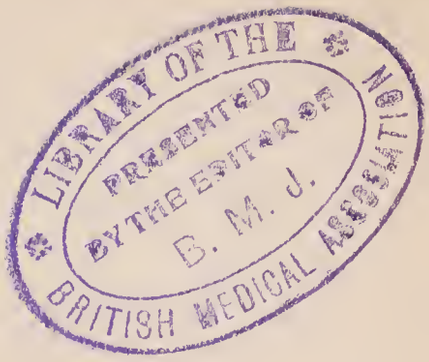
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THE SURGICAL ASSISTANT

The Surgical Assistant

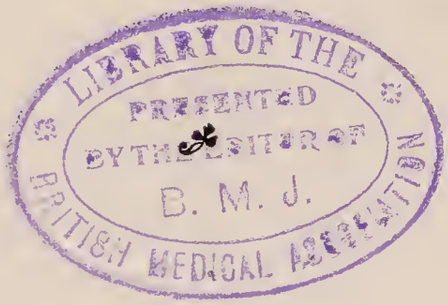
A Manual for Students, Practitioners, Hospital Internes and Nurses

BY

WALTER M. BRICKNER, B. S., M. D.

NEW YORK CITY

WITH 123 ORIGINAL ILLUSTRATIONS



PUBLISHED BY THE

INTERNATIONAL JOURNAL OF SURGERY CO.

MEDICAL PUBLISHERS

100 WILLIAM STREET, NEW YORK

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TO

HOWARD LILIENTHAL, M. D.

AS A TOKEN OF PERSONAL REGARD, AND AS A
TRIBUTE TO HIS SURGICAL SKILL,
THIS BOOK IS DEDICATED

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PREFACE.

Surgical text-books, even those that deal most minutely with operative technics, make but scant reference to the duties of the surgeon's assistants. And yet the skill of the assistants is scarcely less important than the skill of the surgeon himself. In an operation the surgeon must depend, not only upon the experience and the caution of the anesthetist, but also upon the familiarity with aseptic details, the foresight and adaptability, and the coolness in emergency of those who aid him in the mechanical procedure itself.

If we except a brochure by Dr. Carl Lauenstein—"Der Assistenzarzt"—which in neither scope nor execution has anything in common with this book, nothing known to the author has been written upon this important subject. The volume he presents is then, a pioneer, and as such, no doubt, has its shortcomings.

In spite of these he believes it will be found a helpful guide—to *the student* preparing for hospital examinations or substituting in hospital or dispensary work; to *the hospital interne* who, early in his service, unfamiliar as yet with surgical technics or even with the names and forms of many surgical appliances, is, for a time, embarrassed by the awkwardness of his untutored hands and the slowness of his untrained eye; to *the graduate nurse* who, trained in the hospital operating-room only in the handing of sponges and towels, finds herself confronted in private practice with the necessity of preparing a room for an operation and very often of assisting actively in the operation itself; and to *the general practitioner,* as a volume of reference to aid him in maintaining a large share in the treatment of those of his patients who otherwise would pass from his entirely into other hands. If, in emergency, it occasionally becomes

imperative for one not thoroughly trained in surgery to perform a major operation, how much more often will it be necessary for him to render assistance to the consultant whom he has called to an urgent case! Moreover, the possession of ability to help well would go far to settle satisfactorily the questions of fees; for, sharing in the labor of an operation, and conducting some or all of the after-dressings, are rendering to both patient and surgeon definite and valuable services, well worthy of recognition.

Essentially a technical manual, this work aims to be thoroughly practical, its object being to present clearly and concisely the many important details of method, the valuable little "wrinkles," which, familiar enough to the surgeon and to the trained assistant, have not before been gathered together in print.

The latter part of the book is devoted to the description, from the assistant's standpoint, of various operations, step by step. For this purpose there are selected for consideration only those operations that are commonly performed, those that typify certain groups of operations, those that constitute important emergencies, and those that require special description.

Manifestly the assistant's manipulations must depend, in large part at least, upon the operator's methods; but since the essential and the commonly adopted technics are described it ought not to be difficult to modify them to suit the needs of individual cases.

It will be noted that most of the descriptions are given as though but one assistant (in addition to the anesthetist) were present, and the reader may sometimes think the author has forgotten that an assistant has but two hands. In fact, however, there are few operations that cannot be conducted with but one assistant, and, in emergency, only one may be available. In such cases the assistant must often make his two hands do the work of three or four. When, however, a full quota of assistants is present the proper distribution of their duties may be derived from a reference to the earlier chapters.

Especial care has been taken to make the index useful. It is hoped that the appendix containing the formulary for the preparation of ligature material, surgical dressings, etc., will also prove useful. While illustrations of the instruments in constant use are quite essential to a hand-book of this character, it has been thought best to print them together in a second appendix. The electrotypes for most of these pictures have been kindly furnished by Messrs. George Tiemann & Co. All the other illustrations in the book are the work of Dr. Erwin Reissman, to whom the author expresses his appreciation. He would also thank here Drs. Arpad G. Gerster, Howard Lilienthal, and Paul J. Rosenheim for suggestions, and Dr. Joseph MacDonald, jr., for his uniform courtesy and interest in the publication of the work.

W. M. B.

30 WEST NINETY-SECOND STREET, NEW YORK,
April 15, 1905.

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PART I.

THE SURGICAL ASSISTANT.

PART ONE.

CHAPTER I.

THE CONDUCT OF THE ASSISTANT AND HIS RELATIONS WITH THE SURGEON AND THE PATIENT.

Since many minor procedures and almost all major ones are impossible to the surgeon without help, and since upon the skill and care with which that help is rendered depend in no small degree the comfort and the safety of the patient, the surgical assistant may come at once to a realization of his importance to both surgeon and patient and to an appreciation of his proper relation to each of them. Primarily for the purpose of serving another's needs, his greatest usefulness will lie in forestalling them. However simple or mechanical his duty may be on any occasion, he will always find it is best performed by observing closely conditions as they are developed and requirements as they appear. Manually, he must help in the procedure; mentally, he must himself undertake it; he should be not a pair of hands alone but a brain as well. His usefulness thus developed, he is often in a position to make a suggestion that may help the solution of a knotty problem. This is especially true when, as should often be the case, the patient's physician is, for the nonce, the surgeon's helper, for he continues as medical adviser even while his patient is upon the operating table; and while technically he is assisting the surgeon, in a broader sense the surgeon is merely assisting him.

If, in the light of his greater experience, the surgeon deems unworthy of adoption any suggestion, however sensible, that should seldom be a cause for offense. During operations especially, the assistant will do well to keep his mouth closed and his eyes open. If he observe this rule, both as a matter of decorum and as an aseptic principle, an occasional suggestion, introduced deferentially, will be regarded with respect,—otherwise it will be as unwelcome as it is apt to be unwise.

It is scarcely appropriate to dwell here upon the necessity of being prepared to inform the consultant surgeon of every detail of a case that may be of importance to him in forming his opinion. This information is all the more valuable when it is a carefully written record. It is not less important to save for his own observation stools, vomits, uterine or other discharges, etc., even if they are of only negative value. The lack of a thorough urinary report may embarrass the consultant very seriously. It will in many instances prove embarrassing to him, too, if there are not also prepared for him such paraphernalia as may be necessary for his examination. Thus, if he may desire to aspirate a doubtful swelling, there should be ready: soap and water, a brush, alcohol or ether (or both), and sublimate solution, for disinfecting the area to be punctured, and similar materials for sterilizing his hands; a sterile needle and syringe (which should be proven to be in working order by actual test); a porcelain or white enamelled dish to receive the contents of the syringe when they are expelled for examination, or, lacking this, a glass dish beneath which may be fastened a disc of white paper; a small dressing, a few towels, and some absorbent cotton. All these things should be near at hand but, until needed, they should not be within the patient's sight. The requirements for other manipulations will be considered later.

A preparation of the patient's body for examination is seldom necessary and often inadvisable, for it is best for the surgeon to see things in their actual condition. It would, for example, be unwise to administer a douche before a vaginal inspection. On the other hand, an examination of the

abdomen may be difficult because of tympanites that might have been relieved by a preliminary purgative.

Often the assistant will be called upon to prepare for an examination or for some minor procedure hastily, and after the surgeon has arrived. Here he must use nice judgment to secure the greatest convenience to the surgeon with the least confusion in the household. By improvising, and by adapting things at hand to his needs, he may avoid a scurrying about that is sure to distress the patient and to annoy his relatives. On the other hand, it is better to send to the kitchen for a table or a chair than to put bottles or basins upon polished or upholstered furniture. Stains and scratches are unpardonable, and they are lasting and unpleasant reminders of a visit that under any circumstances was anticipated with fear and, often, is recalled with distress.

In most instances, too, it is better to trouble the family for a stone or china dish, rather than spoil even a cheap unenamelled metal one with a mercurial solution. It is the assistant's business to see that the patient's body, clothing and bedcovers are properly protected against soiling by blood, pus, or other fluid. A piece of oilcloth will suffice if rubber sheeting is unavailable or, lacking both, several towels should be used to protect the part most apt to be soiled. A round basin held *against* the body almost invariably fails to catch discharges. If a kidney-shaped receptacle (pus basin) is not at hand, absorbent cotton or towels should be used to receive a discharge not too profuse. Blood-stained, soiled towels, etc., should be dropped into a paper bag or a basin, which may be pushed out of sight or covered with a cloth and carried from the room. When using plaster of Paris, no protection of the patient and his surroundings from the spattering drops can be too careful. Plaster of Paris is no more desired on the carpet or furniture than are stains of blood or pus, and however much the patient may politely insist that "it doesn't matter a bit," he is not apt to mean it. Even if it "doesn't matter" to him, it should to the physician, for carelessness in these particulars is as much bad technics as is awkwardness in operative manipulations. It is not

hard to believe, too, that despite his protestations the patient will conclude to employ in the future a surgeon whose reputation for skill may be less, but whose tidiness is more in evidence, and whoever may be at fault, he is not apt to think kindly of either the surgeon or his assistant, if they leave him wet, soiled and dishevelled.

The assistant should observe the utmost gentleness. This secures the patient's confidence and prepares him to bear with equanimity such pain as is unavoidable. It will probably be distressing to pass an instrument before the patient's eyes, and it is certainly awkward to reach across his body for something that could just as well have been placed elsewhere. A speculum that is cold, or too hot, or dripping wet, or too freely smeared with vaselin is sure to cause discomfort.

When it is necessary to wear a rubber apron it is always best to cover this with a white gown, for rolled shirtsleeves look ungenteel and the apron appears too formidable, while a white gown gives the impression that it is worn as much for the patient's sake as for the protection of the surgeon's clothing. In this connection it must be remembered that the average layman has a very fair idea of the principles of asepsis, and decided and proper notions of surgical cleanliness. However simple the procedure at hand may be, it very properly produces the best impression to have everything used conform with these quite correct notions.

A small amount of blood will produce a large stain, and a small instrument may provoke considerable fear; it is, therefore, always best to keep both implements and soiled dressings out of sight as much as possible and to remove all of them as soon as this can be done.

However hasty an assistant's preparations, they should never be ostentatious. He appears most dignified when his bearing is most modest. Let him secure what he wants quietly, making his requests in an undertone and beyond the patient's hearing. His preparations, too, can be completed with no disturbance to the surgeon. There is seldom need of asking him for instructions; certainly no need of

asking him aloud. He should make ready what *will* be needed, and what *may* be needed.

If a nurse be present, her position should not be made an opportunity to exhibit authority. Orders ought to be given to her in a low voice and carried out as quietly as the assistant himself is working. She should be given the same opportunity to forestall the assistant's wishes as the assistant himself likes to enjoy in anticipating the surgeon's needs.

If the assistant observes something of importance that the surgeon may have overlooked, it is his duty to impart his discovery to the surgeon, and it is also his duty to impart it without attracting the patient's notice. It is in bad taste for an assistant to seek recognition of his acumen. The credit belongs to the surgeon; just as the assistant is responsible to the surgeon and the surgeon is responsible for his assistant. If the patient learns through another that the assistant has made a shrewd and useful observation, he will think the more of it because it was not immodestly proclaimed. In any event, it is bad to discuss the patient's condition in his presence, and bad to indulge in loud talking, peremptory orders, or unnecessary questions.

A patient often seizes an opportunity to learn from the assistant some facts concerning his condition that the surgeon or the family physician may not have imparted. At such a time if the assistant hesitates or stammers, he confirms, perhaps, a fear that no mere statements can remove. He may answer, often truthfully: "I have been too busy helping Dr. —— to observe all the conditions," or "I am not sufficiently familiar with all the facts to form any opinion, but you may rely on what the doctor has told you."

It is obvious from these general remarks that an assistant's conduct may do much to mar, and not a little to preserve, the surgeon's reputation as well as his own, and that if he endeavors to conserve the one he will go far towards increasing the other. It is but a corollary to this that mere manual dexterity is of little value in an assistant without tact and discretion, and that lacking these qualities he is not apt to find his services in great demand.

CHAPTER II.

THE HOSPITAL INTERNE.

The young surgeon's resident hospital service is the most instructive, ought to be the most pleasant, and often proves the most important, period in his professional career. His bearing and his accomplishments during this term of "apprenticeship" profoundly influence and may quite determine his entire future.

The chief attractions in medicine are its intense human interest and the extent to which it draws upon all the arts and sciences; and no time is better adapted than his hospital service for a physician to develop both sides of his profession—the philanthropic and the scientific. Zeal, thoroughness and sincerity; cheerfulness, willingness and punctuality; forethought, breadth and direction; courage, caution and kindness—all these, and more, are expected of the members of a hospital staff.

A due appreciation of these considerations at the outset will properly direct the interne's work and govern his dealings with his colleagues, superior officers, subordinates and patients. In all large hospitals there must be among the medical and nursing corps strict discipline in the division of authority and responsibility. The junior internes owe prompt and cheerful obedience to the resident surgeon (house surgeon), who in turn is directly subordinate to the visiting surgeon.

Upon the house surgeon falls the responsibility for the details of treatment and nursing of the patients, the complete records of all cases, the proper conduct of the wards and operating rooms, the economical use of hospital supplies and the division of duties among the members of his staff. The *esprit de corps* of his assistants will depend chiefly upon

himself; on the other hand, to the extent that the junior internes and nurses are loyal to the house surgeon will he, in turn, be inclined to shield them from criticism.

The relations between the juniors and the visiting surgeon are indirect. The house surgeon is the intermediary; and, during rounds and operations especially, all reports and, in a whisper, all questions and suggestions should be addressed to him. It is to the best interest of the patients that the bearing of the house-staff in the wards should at all times indicate respect for the surgeon in charge. Even among themselves it is, to say the least, in bad taste for young hospital men to ridicule the judgment of their seniors, from whom those young men have learned whatever they may know. Mistakes are made by all; and an experienced man often has better reasons for being wrong than an inexperienced one may have for being right.

Aside from the strictly surgical manipulations the performance of most of the details of treatment devolves upon the nurses. Among their corps the same division of authority obtains as among the medical attendants. The head nurse in each ward is directly responsible for the work of her assistants to the house surgeon, and all his directions for nursing should be given to her. A woman, occupying, while on duty, a subordinate position,—it is only fair to her that the interne should exercise considerate regard for her physical limitations and her natural sensibility, both in the character of his orders and in the manner in which he delivers them. A nurse's education in medicine is very elementary and much that the physician does is more or less mystifying to her. If the interne will explain to her the rationale of his procedures, he will at the same time arouse her interest in the results and engage her more intelligent co-operation in securing them. Moreover, pupil nurses are in the hospital for the same purpose as are the internes,—to acquire at the bedside what cannot be learned from text-books and lectures. Naturally, therefore, the nurses look to the resident staff for instruction.

Indeed, however it may be conducted, every hospital is a school of medicine for all concerned in the care and observa-

tion of its patients, from the surgeon-in-chief down to the probationary nurses,—and, indirectly, for the medical and nursing world at large. Even an ignorant patient understands this, and he thinks the more of the interne who exhibits a scientific zeal in the study of his ailment. But the interne has deservedly lost all the patient's regard when he allows the scientific to absorb or obscure the human side of his work—when, in other words, he loses sight of *the patient* in *the case!* The patient should be made to feel, that above all other interests in him, the doctors are most concerned in his comfort and his recovery. Certainly it is a breach of professional relations and, no less, of all sympathetic regard, to declare in a patient's hearing that, for example, the distressing pulsations of a large aneurism are "very pretty." But more than that, sick men try to read their fate in the countenances and gestures of their medical attendants and a shrug of the shoulders on the part of one of them may blast some poor fellow's hopes of recovery.

The hospital accepts a sacred trust from every sufferer it receives, and in this trust each interne has a share. He owes to the humblest charity patient no less than to the occupant of the best private room, unceasing watchfulness and attention, gentleness and sympathy. Not even the rush and hurry of an active surgical service excuse prolonged or repeated examinations when a patient is sleepy or in pain, nor dressings during the meal-hour. A change of dressings may be either a trying ordeal or a source of much relief to the patient, and in either event it should be conducted at a suitable time, gently, thoroughly and with all surgical cleanliness. Healing is hastened and comfort is secured by keeping the neighborhood of the wound free of germ-harboring crusts, epithelial scales and dried blood.

History-taking is to be conducted with the same thoroughness and consideration. A time should be selected, if possible, when the patient is not in great pain nor drowsy. A sleepy or suffering patient does not furnish a very satisfactory anamnesis nor does a patient who becomes restless or ill-humored under prolonged questioning. Often an event

or a symptom which the patient deems too insignificant to relate is of the utmost importance. The house surgeon should therefore select for history-taking those internes who have served sufficiently long to be skilful in questioning and experienced in etiology and symptomatology. The histories of patients too ill to question should be secured as soon as possible from an intelligent near relative.

Following a record of the patient's name, age, sex and birthplace is entered on the first bedside sheet the *family history*. This consists in a statement of hereditary family tendencies and similar relevant data. Then follows the *previous history* which should include [the manner of birth], diseases of childhood, subsequent ailments and injuries, residence in tropical countries, etc., venereal infections, alcohol and tobacco habits, etc. The *present history* is ordinarily started with the observation of the first symptom directly related to the patient's ailment. Both the previous and present histories are very important and it requires much careful questioning to elicit all the facts and much patience to secure a record of symptoms in their proper order. The present history is to be summarized with a brief statement of the patient's chief complaints at the time.

Following these, there is entered the *status praesens*—a physical examination of the patient as dictated by the house surgeon or visiting surgeon on rounds. The habit of making complete examinations in all cases—even of patients with no other ailment than hemorrhoids or a hernia, will prove a vastly instructive one.

The *subsequent history* consists of a careful record of observations, which should be *entered at the time they are made*. Many observations not important to the individual case are still noteworthy in that they may form the basis of important statistical studies in other directions. The reports of all laboratory examinations should be duly copied in, or otherwise incorporated with, the history, and photographs or skiagraphs are mounted on cardboard of the same size as the bedside sheets, to be bound with them. Operations are to be described in the record within a few hours after they

are performed. Details are important—thus a statement of the number, character and location of non-absorbable sutures should always be made. A sketch may greatly illuminate the description. The record of the narcosis is to be included. As each patient is discharged, or dies, his history is to be turned over to the interne in charge of it. The final notes are then entered, *e. g.*, a reference to, or copy of, the autopsy report, and the record is indexed by the patient's name and cross-indexed by diseases and filed away for binding.

The interne should make a point of accompanying the house surgeon upon the rounds of the visiting surgeon, for it affords him an opportunity to learn methods of diagnosis. For these rounds the patients' records and various reports should be ready for presentation by the house surgeon. By gestures or whispers the junior may correct misstatements of the house surgeon but, obviously, he should never contradict him aloud. Fresh dressings and sterile instruments are also to be ready for the visiting surgeon, and one, at least, of the internes should also be " washed up " to assist him.

The house-staff rounds are likewise important to the junior for they allow him to observe symptoms that have been noted by his colleagues, and to discuss diagnosis and methods. Less restrained than the rounds of the visiting surgeon, they are none the less serious, and they should never be allowed to degenerate by inattention, flirtations or frivolity.

CHAPTER III.

ASSISTANCE IN EXAMINATIONS AND DRESSINGS.

The proper disposition of the assistant's hands and body, so essential to good technics during operations—in connection with which subject it can be discussed more at length



FIG. 1. Manner of holding a child firmly in the sitting posture.

—is not less important during the conduct of examinations and dressings. It is, indeed, more difficult to handle the conscious than the anesthetized subject, since in the former

case the patient's comfort must be conserved as well as the surgeon's convenience.

For restraining struggling children, the illustrations here given afford suggestions. Figure 1 illustrates a very useful method and indicates the general principles involved. The position is intended chiefly for manipulations about the face, throat and neck. To restrain the child's arms a sheet wound tightly about its body may be substituted for one of the assistant's hands, which is then left free for holding a mouth-



FIG. 2. Manner of holding a child upon a table.

gag or for other service. Figure 2 suggests the manner of restraining children upon a table. Here the assistant stands opposite the surgeon; his arm and forearm on the side next to the table are thrown over the child's lower extremities and the corresponding hand grasps the hands of the patient; with the other hand the forehead is held firmly and the child's head is turned in the direction required.

When it is necessary to hold a child high, as for examination of the throat by the light from a chandelier, it will often be found useful for the assistant (or parent) to turn the



FIG. 3. Proper manner of holding foot during application of bandage.

patient so that its head faces over his left shoulder. The assistant's left forearm then supports the child's buttocks and, with the corresponding hand, encircles its wrists and thighs, while the right hand grasps the occiput. If the child is unruly it would be well to further restrain the lower extremities by wrapping them in a sheet or towel. For many manipulations about the head, *e. g.*, galvano-puncture of nevi, the surgeon is often required to grip it between his thighs. The assistant, seated opposite, then holds the child's lower extremities in a similar manner in his own lap, seizing the child's wrists with one hand, and, with the other, manipulating the sponge electrode.

During the application of dressings, especially immobilizing dressings, it is important to maintain the part in the

proper position with the least obstruction by the assistant's hands. A single illustration will suggest the proper methods. During the application of a dressing to the leg, one or two fingers under the heel will amply support the extremity; the other hand grasping the toes, steadies the limb and maintains the proper flexion of the foot, and the assistant's arms and body are disposed so as to offer the least interference with the surgeon's movements. Unless otherwise indicated the foot should be flexed to, or beyond, a right angle, and if the dressing applied is of plaster, starch or other firm material, the foot should also be held inverted until the application is dry. When the assistant cannot spare a hand to maintain flexion of the foot this can be accomplished by the patient himself drawing upon each end of a long strip of bandage passed about the toes or beneath the ball of the foot.

FRACTURES AND DISLOCATIONS.

The assistant's work in the treatment of fractures and dislocations consists in counter-traction during the manipulations of reduction; and in the maintaining of the reduction, or in application of the dressing while the surgeon holds the joint surfaces or the bone fragments in the desired position.

Of the method of exerting counter-traction little need be said here, since in each case it must be suggested and governed by the manner and direction of the traction. It is important, however, that the assistant should so dispose his hands and body, that while he does not impede, by either, the movements of the surgeon, he is able to grasp firmly and to exert a steady pull without slipping of the fingers and without cramping of the muscles of his arms or hands. *Gripping between the fingers and the palm* is often firmer and less tiring than gripping between the thumb and fingers. Fig. 4 illustrates the application of these principles in exerting traction and counter-traction for reduction of a forearm fracture.

When the surgeon, often after tedious manipulation, has secured the proper reduction of the fragments of a fractured bone and has assured himself, so far as he can, that he has freed the ends of fragments of soft tissue, he may deem it

unwise to remove his fingers until the reduction has been secured by a dressing, the application of which will then fall to the assistant. Therefore, while the dressing of fractures belongs rather to a work on surgery, a few words about the materials used and their method of application will not be out of place here.



FIG. 4. Maintaining reduction of forearm fracture. Note position of assistant's fingers, arms and body.

Padding.—Padding used for the prevention of pressure sores is most often of common or absorbent cotton. When needed, it should be applied freely over all projecting points, *e. g.*, the iliac spines, the malleoli, the heels (as in using Buck's extension apparatus). For padding the axillæ and the mammæ in the use of any dressing that is to remain longer than a few days soft gauze, smoothly applied, is preferable to cotton, for the latter soon becomes matted and stiff by absorption of a sour-smelling, acrid secretion, and thus favors the production of the dermatitis it is intended to prevent.

Before applying protective padding in the axillæ or under the breasts, the parts should be washed with soap and water

and then with alcohol, then dried carefully and dusted over evenly and freely, but not *too* thickly, with starch or talcum powder.

Pads that are intended to exert, rather than to prevent, pressure should be made of gauze, folded into a sufficient thickness and trimmed to the exact size required. They may be fastened to the skin or to the splint by strips of adhesive plaster, or allowed to hold their proper position by the pressure of the dressing alone.

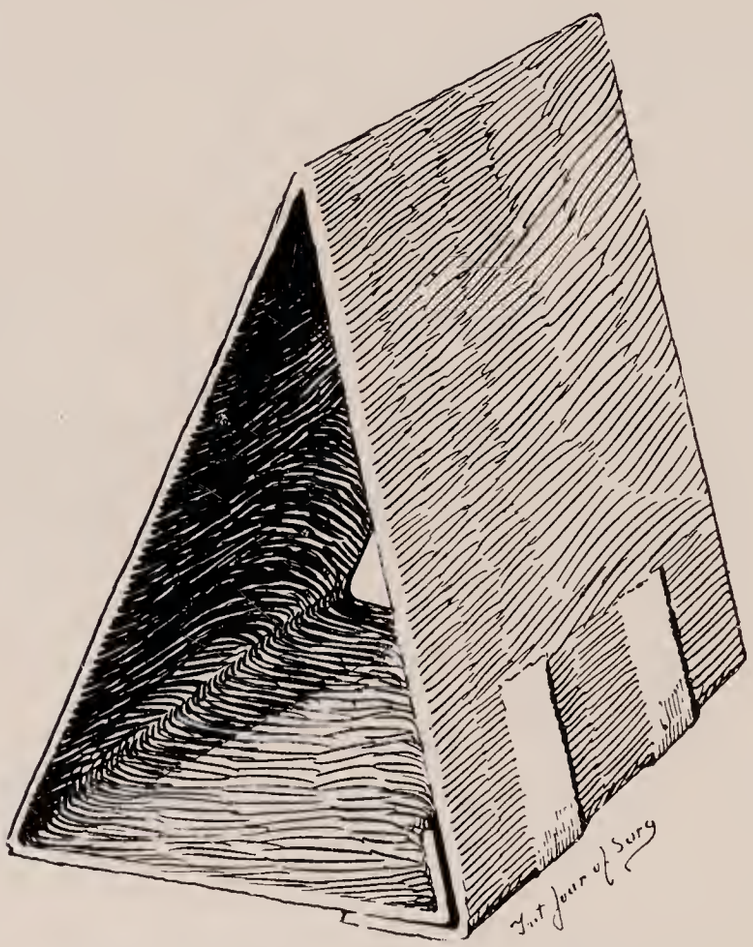


FIG. 5. Triangular cardboard axillary pad.

Triangular axillary pads, such as are needed in the dressing of fractures of the humerus, may be quickly fashioned from heavy manilla cardboard. This is cut the width of the axilla, and bent into triangular shape, the ends being secured by strips of adhesive plaster. The pad is covered smoothly with gauze and held in place with adhesive strips passing

over the opposite shoulder. Triangular pads may be similarly fashioned for the popliteal space or the elbow.

Splints.—Two kinds of wood lend themselves most readily to the fashioning of flat splints—thin pine, and cigar-box wood. Of the latter, two or more thicknesses are usually needed. Such splints should be cut to appropriate length and breadth, and should, ordinarily, have rounded ends. Cigar-box wood is very readily trimmed to proper size and shape with a pocket-knife or with bandage scissors, and, although it splits easily, there is but little difficulty in cutting it to fit rounded parts, *e. g.*, the thenar eminence. Gauze,



FIG. 6. Padded straight splint.

folded smoothly in several thicknesses, is the best padding. It should be long enough to prevent contact between the skin and the edges of the splint, and may be fastened to the latter with a bandage or, more elegantly, with adhesive strips.

Cigar-box wood may be readily molded to a curved surface (*e. g.*, the arm) in the following manner. The splint is laid upon the face of a piece of adhesive plaster of the same size. Then, with a knife, parallel slits are cut longitudinally through the wood and down to, but not into, the adhesive plaster. In this way, a firm, transversely flexible form is made, hinged upon the plaster and capable of being molded to the extremity. The greater the curve of the surface to which such a splint is to be applied the narrower should be made the strips into which the splint is divided.

Basswood veneering is a most useful material for reinforcing immobilizing dressings and, with starch dressings especially, affords an elegant, light, but strong and durable splinting. It is readily torn into strips and being very flexible, can be applied lengthwise, spirally or circumferentially. Its flexibility may be increased by soaking it a few minutes

in warm water. In applying a starch dressing over the leg and foot the veneer strip run anteriorly may be split into several pieces over the dorsum pedis and there spread out like a fan. When used for immobilizing the knee or ankle in a dressing not absolutely rigid, it must be remembered that thin strips of veneering will be apt to crack in the popliteal space or in front of the ankle. At such levels, therefore, they should be made to pass to the sides of the joints or should be reinforced by some heavier material.

Reinforcing strips are most useful when incorporated *in* the bandage, rather than *under* it. Thus veneering strips may be introduced during the application of the starch bandages—a turn or more of the bandage between the strips.

Tin Strips are very useful for reinforcing plaster dressings. When not too heavy they may be curved about flexed joints, but the assistant must be very careful to see that the surface, and not the edge of the strip, is at all points flat against the dressing. Perforating the strips *with an awl* makes them less liable to slip in the plaster. The holes should be punched at frequent intervals and alternately inward and outward, so that the rough-edged awl-hole can afford a better "grip" for the plaster. It must be borne in mind that metal strips, unless very narrow and used sparingly, greatly interfere with the x-ray examination of the parts so important after dressing a fracture.

Heavy cardboard splints, used in immobilizing the elbow, etc., should be fashioned by *tearing,* not by cutting, for torn edges are thin and readily molded to a curved surface. At the angle corresponding to the joint the molding is facilitated by one or two incomplete transverse tears. Moistening the splints in water adds to their flexibility.

Starch (Dextrin) Crinolin Bandages are to be softened in warm water, squeezed out, and freed of loose strands, before applying. They shrink markedly in width when moistened and therefore even for finger dressings the assistant should not select one narrower than one and a half or even two inches. Starch bandages applied too thickly will be found to dry only in the outer layers, the deeper ones

remaining moist for many days. They should not be applied next to the skin, nor directly over absorbent cotton. In addition to their use for immobilizing, a few turns of a starch bandage serve admirably to prevent an ordinary dressing from slipping, as from the finger or the head. The stiff starch bandage may easily be removed by cutting it through with a pocket knife or by moistening and unrolling it.

Plaster of Paris.—Ample protection to the patient's clothing, furniture and floor should be secured by means of linen or rubber sheets. The assistant will do well to cover also his own shoes and clothing.

After cleansing the patient's skin and dusting it with talcum powder, flannel bandages should be applied smoothly

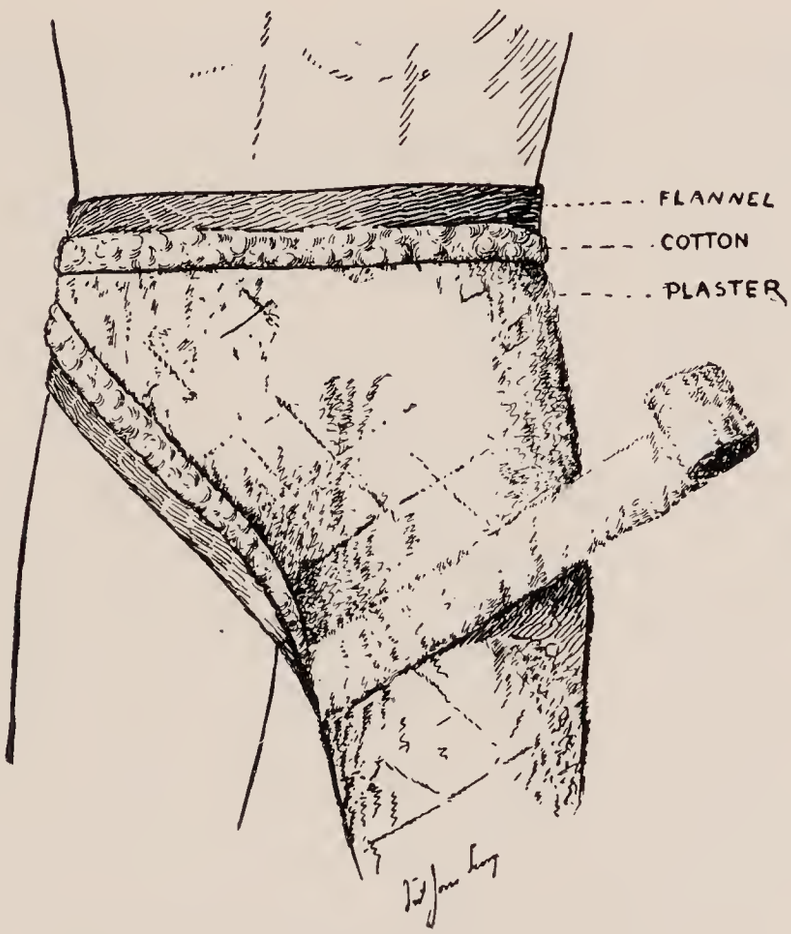


FIG. 7. Plaster dressing—arrangement for making soft cuff.

over the part, extending two or more inches beyond what are to be the edges of the plaster dressing. Over the flannel is

smoothly laid absorbent or, better, non-absorbent cotton,—over projecting parts or on the entire surface or in a ring at the ends of the dressing. The cotton extends only to within about two inches from the ends of the flannel, but a little beyond the levels where the plaster dressing will stop. On many parts of the body, *e. g.*, the lower extremity, hip and chest, a white stocking or circular stockinet or a section of balbriggan underwear, may be applied smoothly next to the skin, instead of the flannel bandages.

To prevent the plaster from adhering to his hands the assistant may now anoint them with vaselin (especially about the finger nails) or, better, cover them with rubber gloves, or with Murphy's gutta-percha solution (page 77).



FIG. 8. Freeing bandage of frayed edges.

Plaster of Paris bandages should be very loosely rolled and the powdered plaster should be evenly and smoothly distributed in the meshes of the crinolin. They must be kept in

air-tight containers, *e. g.*, tin canisters sealed with adhesive plaster. One by one, *as needed,* the bandages are *submerged* in a basin of lukewarm water and held there until they cease to give off bubbles. It is essential to cover the entire bandage at once with the water, and it is best to use a basin deep enough to submerge the bandage end up. A little salt added to the water hastens the setting process, but tends to make the finished dressing less firm. It is unnecessary, since good plaster sets quickly. When the bubbling has ceased, the assistant lifts the bandage from the water and, still holding it over the basin, gently squeezes it. Each edge is to be quickly freed of all loose threads. The beginning of the bandage is then found and opened out a few inches. With



FIG. 9. Handing plaster bandage.

this part held in his right hand and the body of the roller, facing upward, in his left, the assistant places the bandage in the hands of the operator in such a manner that it can, thus,

be applied to the dressing. If the operator is left-handed the assistant reverses the position of the bandage, keeping the roller upward.

If the assistant is called upon to apply the bandage himself he must be careful to exercise no pressure, but to allow the roller to pass about the part with scarcely greater tension than its own weight.* During their application both operator and assistant should continuously smooth out the plaster bandages with the fingers and the palms of the hands. This is to be done rapidly and always in the same direction (that in which the turns are made) to keep the edges of the bandages flat. If the bandages are "thin" this smoothing process may be used to incorporate a little extra plaster paste, scooped from the bottom of the basin in which the bandages are wet, or made in the palm of the hand from dry plaster powder and water. If it is found that a bandage has begun to set before all of the roller is applied, the assistant should cut off the unused part and prepare a fresh bandage. Between turns of the dressing reinforcing splints of tin, wood, etc., may be incorporated. The plaster bandages themselves may be used to reinforce special parts, *e. g.*, the ankle, sole of the foot, groin, etc., by passing them backwards and forwards several times over these points.

Before the last bandages are applied near the edges, the projecting flannel is turned down over the cotton and the plaster, and is then held in place with a few turns of the plaster bandage. Thus are formed neat, soft, even cuffs. A plaster, starch, or other dressing applied over the groins of children or feeble adults may be protected from soiling with urine, by incorporating in it a large piece of rubber tissue turned over the edge and covered by the last turns of the dressing. The smoothing process should be continued for several minutes after all the bandages have been put on, until the dressing is even and of graceful contour, and the edges and meshes of the bandages are lost to view. Plaster

* There is some discussion as to whether or not plaster contracts in setting. Be that as it may, if the bandage is applied more tightly than above described the cast will be too tight.

is heavy at best, and the assistant should therefore make the dressing no thicker than it has to be. The final smoothing requires but a very thin paste or no paste at all.

The assistant should see that the patient maintains the proper position from the beginning of the dressing until the plaster is dry. Applied to the leg only, the heel may be supported upon a high cushion or a chair. Applied as a hip-spica, or about the trunk, a hip-rest must be used if the patient is recumbent. Applied to the leg and foot, it is essen-

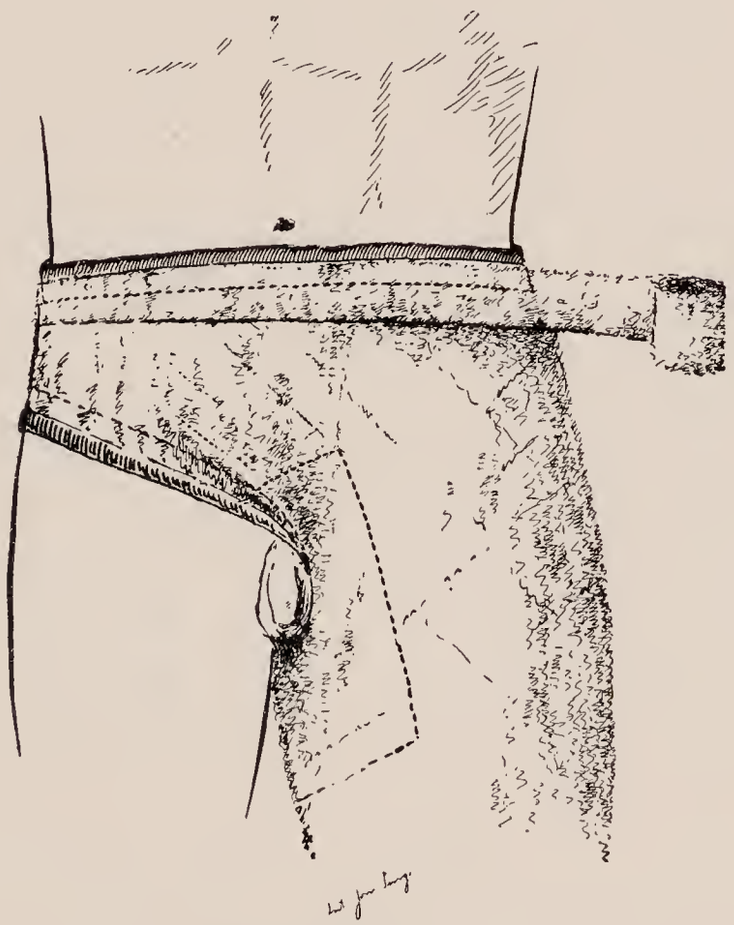


FIG. 10. Plaster dressing—smooth cuff formed. Dotted rectangular line about genitals indicates sheet of gutta-percha.

tial that the latter should, in most cases, be held inverted and at right angles. If no assistant can be spared to grasp the toes for this purpose, the position may be secured, as described before, by passing a gauze bandage under the ball of the foot and placing its ends like a pair of reins, into the hands of the patient. Finally, before the assistant leaves

the patient he should make sure that the dressing is not tight enough to impede the circulation in the part. In dispensary and hospital practice it is convenient to mark upon fracture dressings, in ink, the date of their application.

As soon as possible all open but unused cans of plaster or plaster bandages should be tightly closed and sealed with a strip of adhesive plaster over the overlapping edge of the cover.

The preliminary cleansing of the hands of plaster should not be performed in a plumbed basin, but in a portable one for otherwise the drain or trap may be occluded. Rubbing with granulated sugar aids somewhat in removing plaster from the hands, as does also the addition of a tablespoonful of sodium carbonate to the water in which they are washed.

The removal of a plaster dressing requires as much patience as skill. An excellent tool for the purpose is a carpenter's miter saw. Also useful, but less satisfactory, is a well pointed pruning knife. The track through which the knife is to pass may be softened by means of strong acetic acid applied from time to time with a brush or a dropper. Heavy plaster shears are of use only when the dressing is of little thickness. As in the application of plaster, so before its removal the patient and the floor should be protected from soiling.

CHANGE OF DRESSINGS.

The dressing of a recent aseptic wound requires the same preparations on a small scale that operations do on a large one. For use in the dressing of granulating or suppurating wounds, however, freshly laundried towels may be considered surgically clean. They may, moreover, be rendered sterile by soaking in a strong solution of bichlorid of mercury ($\frac{1}{5}$ per cent.) or of carbolic acid (5 per cent.) Forceps, probes and scissors may be rapidly and effectually sterilized for a small dressing by passing them through an alcohol or Bunsen flame. Jeweller's aluminum tweezers and aluminum probes may be repeatedly sterilized in this way, but expensive

instruments should be "boiled." "Wipes" made of dry sterile gauze, or smooth balls of absorbent cotton soaked in a sterile solution, make satisfactory sponges. A sufficient number of them should be prepared in advance and, indeed, "packings," pads, lunar caustic, irrigating solutions at proper temperature and all else that will be needed should be made ready before the dressing is begun, in order to avoid unnecessary delay.

The patient should first be placed in a comfortable position and protected by a rubber sheet, if necessary, against soiling of his body or bedding. A towel is slipped under the part, pins are removed from the dressing and placed conveniently



FIG. 11. Arrangement for dressing wound of the neck. Note hair gathered up under towel and head supported by assistant (nurse).

at hand, *e. g.*, in the assistant's coat or apron, and the bandage is cut through from below upward and in a line *not over the wound.* The superficial dressings should be removed gently, if necessary moistening them with a sterile solution squeezed from a sponge, *if the hands are clean,* or dripped from a syringe.

The deep dressing should be left in place until sterile towels are placed under the part and around it. Soiled dressings should be removed with *forceps* and dropped at once

into a basin or, better yet, into a *grocer's paper bag*. This is an excellent receptacle for discarded dressings, soiled sponges, etc. If its bottom is spread out, it will stand open even on a bed, and a tear in its mouth will facilitate the introduction of gauze and bandages. The deep dressing should be removed with clean forceps or, if it is aseptic, with disinfected hands. If adherent to the skin this dressing should first be moistened. Upon withdrawing a packing, the assistant should be prepared with a towel or a pus basin to receive a small or large amount of pus or other discharge that sometimes escapes from a wound. The removal of adhesive strips is facilitated by pressing under them a bit of absorbent cotton dipped in benzin. Ether is also excellent for this purpose, but it is irritating to the wound and frequently nauseates the patient.

Oftentimes the assistant must support the part as well as assist with the dressing itself. Figure 11 illustrates how this may be accomplished. Whatever position the assistant is called upon to assume he must above all be careful not to embarrass the movements of the surgeon nor to obstruct the passage of light to the wound.

CHAPTER IV.

PREPARATIONS FOR AN OPERATION.

THE ROOM.

The preparation of a room for operation naturally falls to an assistant, either a physician or a nurse. If left to the latter it is still the duty of the assistant surgeon to overlook the work done and to see that all details have been provided for before the operation is begun. It is necessary, therefore, that he should have an orderly system of preparation and a knowledge of what may be needed, otherwise he will add confusion to a family's distress and, by the omission of something important, invite delay or disaster in the operation.

The comfort of the family, and especially of the patient, is therefore to be considered in the choice of the room for operation, as well as are its size, the arrangement of the light, the proximity of running water, and the heating and ventilating facilities, etc.

The room selected should be large, if possible. A nursery has the advantages that its preparation usually requires but little removal of furniture, and that it can be sacrificed by the family for a few hours without much inconvenience. The dining-room is well adapted to the purpose, for it is often uncarpeted, is usually well-lighted, and being near the kitchen, is convenient for washing, sterilizing, the selection and carrying of basins, and the speedy removal of soiled articles when the operation is concluded. The operating room should be near to, and, if possible, on the same floor as the patient's bedroom. The latter may itself be used for the operation—the patient retiring to another room during the preparations. This arrangement is convenient when the patient is too heavy to be carried far, and it saves him the

exposure of transportation through a sometimes cold hallway. On the other hand, it has the serious drawbacks that the sickroom, which from the first should be fresh and well-ventilated is, instead, filled with fumes of chloroform or ether, and littered with paraphernalia that cannot easily be removed without disturbing the invalid.

The room selected, the assistant should next see that there are provided those supplies—most of them obtainable at a drugstore—that will be needed. They are:

1. Three cheap, unvarnished hand-brushes.

2. Green soap, ℥ ii; or "marble soap";* or "synol" or other antiseptic soap.

3. One or two orange sticks or new meat skewers, or other nail cleaners.

4. One pint of alcohol, 95 per cent.

5. Two or more five-yard jars of plain sterilized gauze.

6. One one-pound, or two half-pound cartons of sterilized absorbent cotton.

7. Bichlorid of mercury tablets.

8. Purified chloroform, ℥ iii ss (original bottle).

9. Two or more cans of purified ether, ℥ iii ss each.

10. Tablets for hypodermatic use,—strychnin, nitroglycerin, morphin, atropin.

11. Whiskey.

12. Washing soda.

13. Safety pins.

14. Vaselin or albolene for the anesthetist.

15. Razor; shaving brush.

16. Pure carbolic acid, ℥ i-℥ ii.

17. Chlorid of lime; carbonate of soda.

18. One demijohn of distilled water.

19. One two-quart fountain syringe.

* A mixture of soap and marble-dust for removing scales of epidermis.

20. One yard or less of surgeon's gutta-percha ("rubber tissue").

21. One roll of adhesive plaster of suitable width.

22. One five-yard jar of iodoformized gauze, 5 per cent.

23. Gauze or muslin bandages.

24. Cheese-cloth for a binder.*

25. Rubber tubing for drainage tubes.

26. Oilcloth or rubber sheeting for the table.

27. Oilcloth or tar-paper for the floor.

Of these supplies some may be provided by the surgeon, several may be found in the house, and some or all of items 14 to 27 may be unnecessary. Again, the tastes of the operator or the needs of the case may make it necessary to secure other articles, for example: crystals of potassium permanganate and of oxalic acid; plaster of Paris bandages; flannel bandages; non-absorbent cotton; collodion; sterile adhesive strips; hydrogen dioxid; lysol; creolin; boracic acid; adrenalin; cocain, chloretone, eucain, or other local anesthetic; chemically pure sodium chlorid or "infusion tablets;" formaldehyd solution, etc.

Gauze commercially sterilized should be in jars, tubes or tin cans, rather than in pasteboard cartons. If it is necessary to economize there may be ordered one jar for packings, sponges, and the inside dressing, and one or more cartons for the outside dressing. It is desirable then to select cartons in which the gauze is packed in layers rather than those in which it is packed in a roll, all of which latter must be lifted out in order to cut off a small piece.

Before arranging the room itself, the assistant should direct the sterilization of a sufficient number of towels. Dry sterilization in the kitchen oven is objectionable, in the

* A towel serves admirably for children and slender adults; for stout subjects towels may be stitched end to end.

writer's opinion, because without a suitable thermometer there is no assurance that the temperature is sufficiently high unless, as is often the case, the towels are actually burned. Soaking in sublimate solution, 1-500, is better, but sterilization by steam or by boiling water is best of all. A large kettle should be filled with water and placed upon the fire in the kitchen or, more conveniently, upon a gas-stove in or near the operating room. A capacious wash-boiler, if at hand, is preferable to the kettle for it will accommodate towels, sheets, basins, hand-brushes, fountain syringe (which, if new, should first be rinsed out with running water), orange sticks and a pitcher, and it will afford, in addition, a large stock of hot, sterilized water.

From the fund of towels that can be spared for the operation, six to twelve should be laid aside to use dry. One to two dozen, preferably without fringes and free from holes, should be wrapped up in one or two packages, enclosed in a towel or a sheet and dropped into the wash-boiler or suspended in its steam.

If the supply of towels is small, clean dish-cloths or discarded napkins may be substituted; or one bed sheet may be used to take the place of many towels. Strips of bandage may be tied by one end to a handle of the clothes-boiler, and by the other end to the towel packages and other articles being sterilized, thus affording a ready means of lifting out all of these from the hot water. If there is at hand no receptacle large enough to hold the basins for boiling, or for their immersion (for fifteen minutes) in $\frac{1}{10}$ per cent. sublimate solution, the assistant, while busying himself with other details, can direct the sterilization of the basins in the following manner: Each one is thoroughly scrubbed with water and soap, then scalded with boiling water. Into one is then poured two or more ounces of pure carbolic acid which is made to circulate over the surface. Most of this is then poured into the next basin and the process repeated, the excess of carbolic acid being poured into the third basin, and so on. To the carbolic acid remaining in each receptacle is then added enough hot water to make a carbolic acid

solution of about 3 per cent. to 5 per cent. strength. This is flowed several times over the interior and the edges, and after standing a few minutes is poured out. The basins are then rinsed out with boiled water. Once sterilized none of them should be handled by the rim and, it need hardly be added, dishes not sterilized by boiling should not be piled upon one another.

Enamelled basins are, of course, the most suitable, but there is no need to purchase them, cheap though they be. Even a poorly furnished kitchen will usually contain all the basins needed for any operation. Kitchen bowls, dishes used for mixing dough, and soup tureens answer admirably for sponge-, and hand-basins, and soup plates will serve for ligature dishes, etc. If instrument trays are needed and are not supplied by the surgeon, clean baking pans and platters may be pressed into service, but it will serve as well to spread the instruments out on sterilized towels. The following list includes all the basins, trays, etc., that will be needed:

Three hand basins for sublimate solution.

One hand basin for alcohol.

Two large sponge basins if sea-sponges are used.

One basin to contain strong sublimate solution for ligature bottles and tubes, and gutta-percha.

One small basin for sponge to cleanse instruments.

One or two dishes for ligatures and sutures.

One or two pans for instruments.

One dish for soap and water to cleanse field of operation.

One slop-jar.

To which may be added:

A basin for hot pads.

A bowl to receive pus or other discharge.

A cup or saucer to serve as a specimen dish.

Two basins for solutions of potassium permanganate and oxalic acid, respectively.

A dish for salt solution.

A shaving mug, and

For the Anesthetist:

A basin, and **a tumbler for boiled water.**

Having inaugurated the sterilization of the towels, dishes, etc., the assistant can now give his attention to the arrangement of the room itself. Enough furniture should be moved aside to provide ample space. It is unnecessary to clear the room, however, and unless the preparations are made the day preceding the operation, dusting, sweeping, and the moving of pictures should be avoided. Sheets may be spread over furniture, mantel-shelf, and ornaments, but this is not necessary. Where the operating table is to stand the floor should be protected with a piece of linoleum, or lacking this, with old rugs, newspapers, tar-paper, or sheets, tacked down.

For the operating table the kitchen again can usually be drafted upon. Library tables, too, are often suitable, and if necessary two tables may be lashed together, end to end, inequalities in their height being evened by means of a folded blanket or a pillow. The weaker table, if two are joined, should be used for the patient's head—unless that is the part to be operated upon. Obviously, the operating table, if possible, should be placed near the window, when operating by daylight; but it is more important that the light should fall *into* the wound than that the superficial field of operation should receive the greatest amount of light. Thus, for a vaginal hysterectomy the patient's head should be furthest from the window, but for an abdominal hysterectomy the position should be reversed.

Over the table is spread a folded blanket, upon this the rubber sheet, and over both a fresh linen sheet. At the foot of the table is laid a folded blanket or sheet, or both, to cover the patient. At the head is placed a pillow, preferably flat and of hair, and nearby a folded towel. For an operation upon the kidney (*q. v.*) a firm cylindrical cushion or sandbag, or a pillow rolled into a cylinder, is to be laid across the middle of the table.

Beyond the head of the table is placed a chair for the anesthetist and to one side of this a small table or another chair, covered with a towel, for the anesthetist's armamentarium.

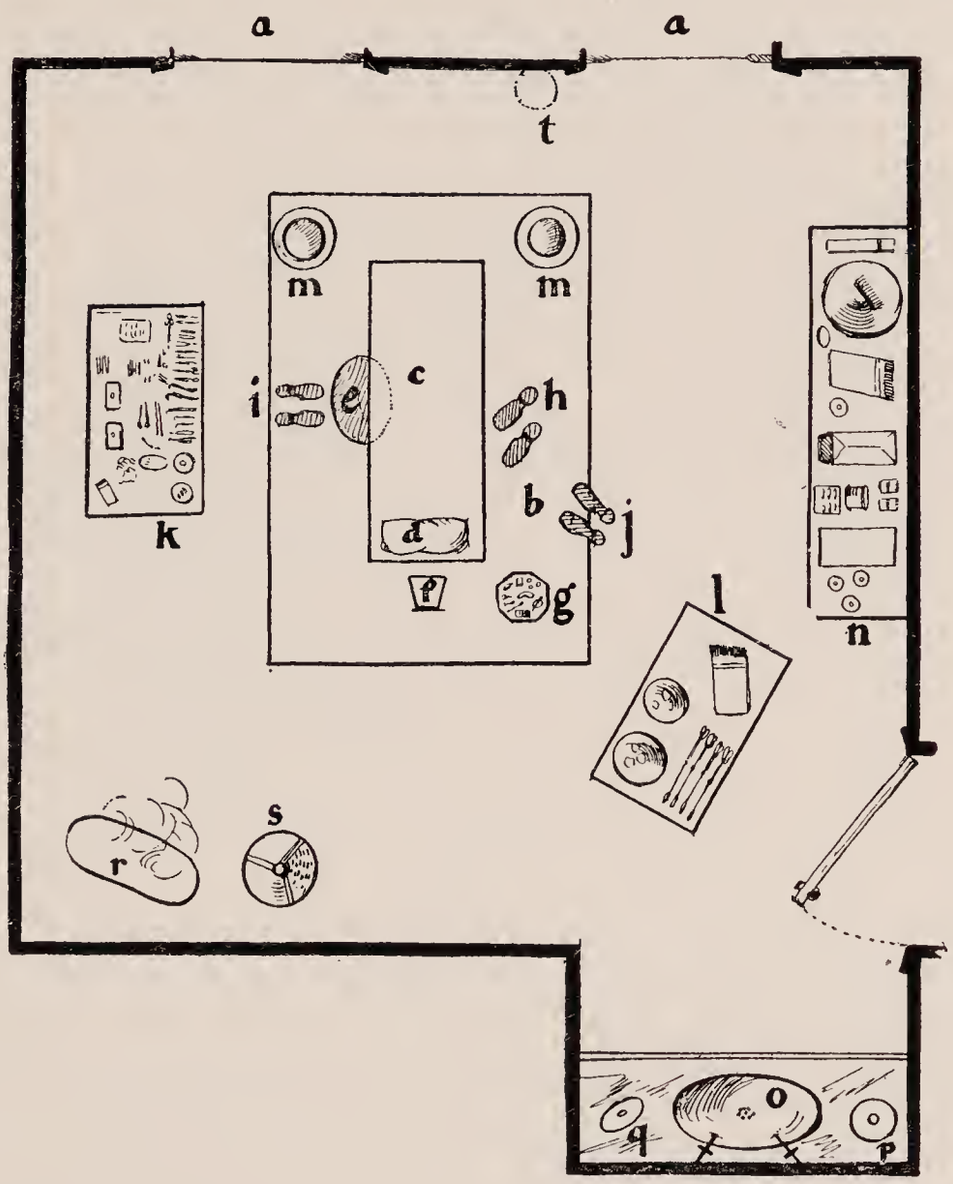


FIG. 12. General scheme of operating room arranged in private dwelling. *a*, *a*, window panes (soaped); *b*, oilcloth; *c*, operating table; *d*, pillow; *e*, slop-jar; *f*, anesthetist's chair; *g*, anesthetist's table; *h*, operator; *i*, assistant; *j*, nurse; *k*, instrument table; *l*, nurse's table; *m*, *m*, hand basins; *n*, mantel-shelf with unsterilized accessories; *o*, wash-basin; *p*, basin of alcohol; *q*, basin of sublimate solution; *r*, boiler of hot water; *s*, demijohn of distilled (cold) water; *t*, irrigating bag.

On each side of the operating table and at a convenient distance from it is placed a chair, stool, or large wooden box (which may also be covered with a towel) for a hand basin.

A slop-pail is then placed on one side of, and partly under, the table. It is best located on the side where is to stand the assistant who sponges the wound. On the opposite side is sometimes needed a footstool for the operator. The Trendelenburg position may be secured by the familiar method shown in the illustration, the table coverings being continued over the back of the chair and the pillow moved to the center of the table.

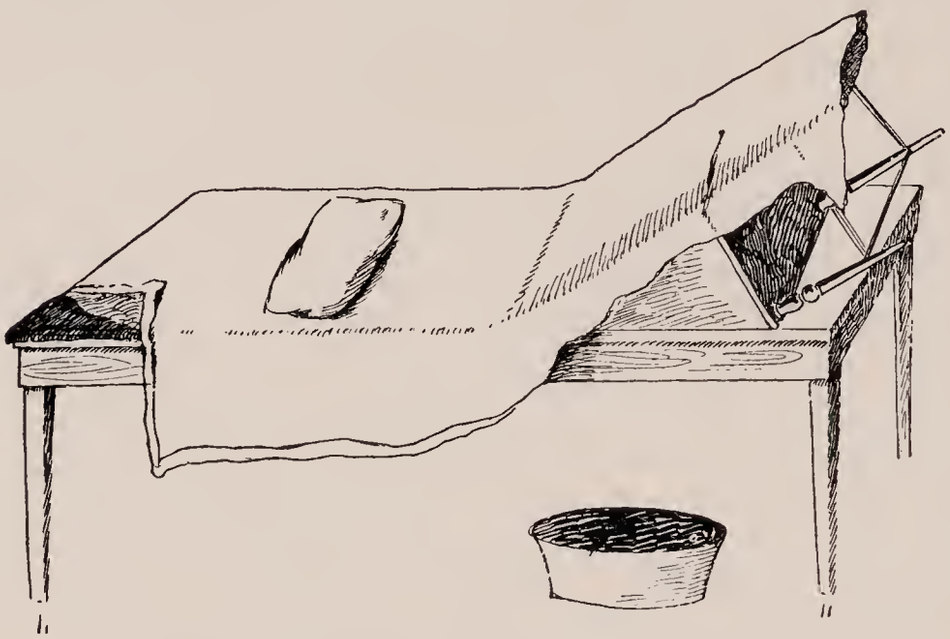


FIG. 13. Improvised Trendelenburg table.

For operations about the perineum, the table is arranged as shown in figure 14. For a Kelly pad may be substituted the rubber sheet. The upper end is tucked about a twisted sheet arranged in a horseshoe; the lower end drains over the end of the table into the slop-pail. The drainage is better maintained by pinning together in front the two lower corners of the sheeting, thus forming a funnel. (The same device may be employed laterally upon the table for other operations. Used for drainage, it will be found economical to purchase sheeting coated with rubber on both sides and therefore easy to free of blood-stains.) At the foot of the table are placed two chairs—one for the operator on the left, the other for the assistant on the right. The hand basins and instrument table are placed nearby. A twisted sheet laid on the operating table in the manner illustrated, to be passed

from behind the patient, over one of the shoulders and tied at the knees, makes an excellent leg-holder. It may be supplemented by a piece of broomstick, two feet long, padded, to be bandaged at each end to the legs to maintain their separation.

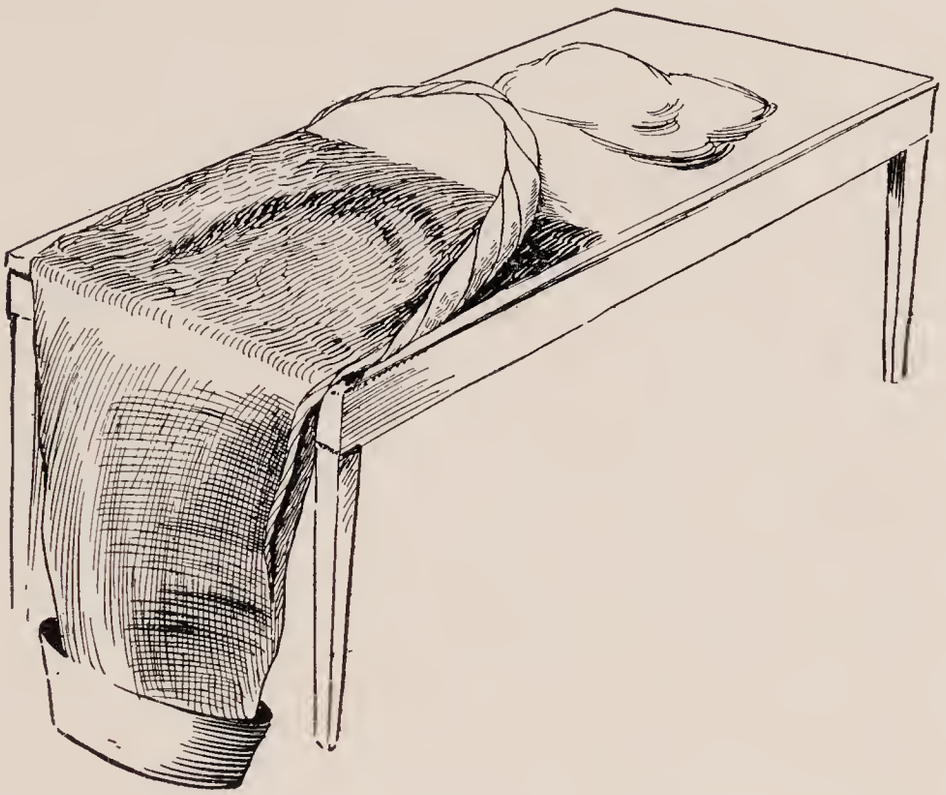


FIG. 14. Table arranged for operation in lithotomy position.

One large table or bureau may be used for instruments, dressings, sponge basins, etc., but it is better, if a nurse or second assistant is at hand, to place one (or two) tables for the instruments and sterilized dressings on the side at which the assistant is to stand, and another table for sponge basins, towels, etc., on the side of the operator. The nurse detailed to the care of the sponges is then able to relieve the operator in the manipulation of retractors, etc. If the assistant is not fairly familiar with the technics of the operation or those of the individual surgeon, it may be well to place the instrument table where the operator can help himself to what he wants. For this purpose an invalid's feeding table projecting over the patient's body is very convenient for holding the instruments in immediate use. These

tables should be covered with sterilized sheets or with towels and, if their tops are polished, with some waterproof material also.

Window-curtains should be drawn aside and pinned or tied back. If it is possible for curious neighbors to see into the room through the window panes, these should be soaped. This is accomplished by passing over them a wetted cake of soap or the palm of the hand smeared with lather. The more irregularly the streaks of soap are applied the more the rays of light will be diffracted.

The assistant now lays out in systematic order upon a bookcase, mantel-shelf or table, the supplies that have been purchased, the operating aprons, gowns and caps, etc. Of these, one or two jars of gauze and the jar of sea-sponges are placed upon the table for sterilized dressings, or at the back of the instrument table.

The sterilized fountain syringe, if one is to be used, may be suspended from the chandelier or, by means of a piece of twine or bandage, from a picture-molding or curtain-pole, thus to avoid driving a nail into the wall. The irrigating solution should not be poured in until just before the operation is begun, and it should be prepared in a pitcher—not mixed in the bag.

The anesthetist's table is now supplied with:

Chloroform and ether, chloroform and ether masks, mouth-gag (appendix, figure 5), screw-gag, tongue-forceps, sponge holder (*e. g.*, a clamp) and sponge, vaselin or albolene, a basin to receive vomitus, a few towels, a safety-pin or bandage for fastening a towel about the head, a tumbler of boiled water, a sterilized hypodermatic syringe and needle, laid across the tumbler and filled with strychnin sulphate, gr. 1-30 dissolved in whiskey.

If a chloroform dropper is not supplied, there should be cut two V-shaped gutters in opposite sides of the cork of the chloroform bottle,—one groove for the entrance of air, the other for the egress of the anesthetic (see page 94). A mask for the administration of chloroform may be improvised by drawing a corner of a towel through a safety-

pin. An ether mask may be quickly fashioned by folding a newspaper twice across its width, and laying this lengthwise in a towel. The edges of the towel are turned in, and the paper and towel are then folded over into a hollow, flattened cylinder of appropriate size. The loose end is pinned down and one of the open ends is also closed with pins. Into the apex of the cone thus formed is stuffed absorbent cotton or gauze. The use of a gas-ether apparatus renders many of these articles unnecessary.

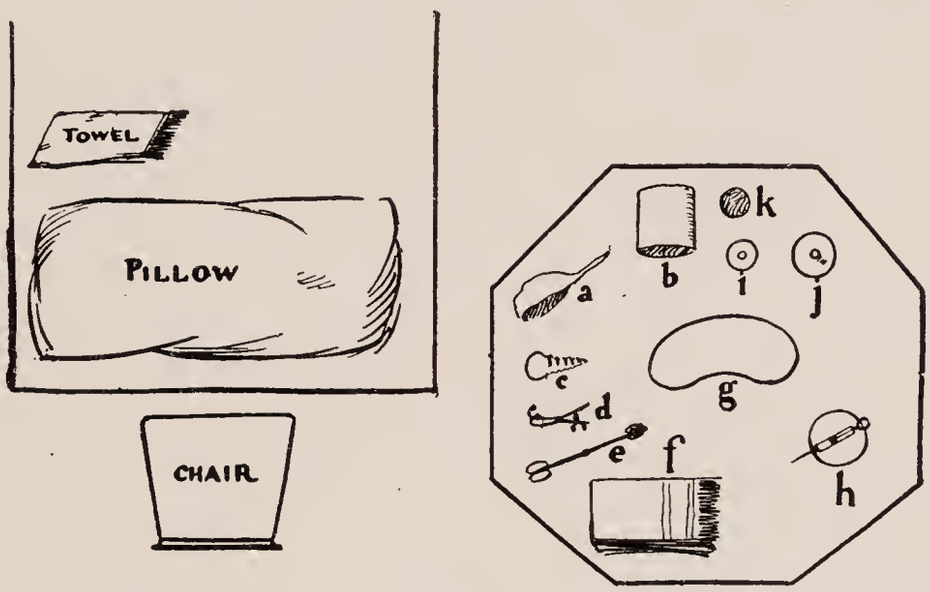


FIG. 15. Arrangement for anesthetist. *a*, chloroform mask; *b*, ether mask; *c*, screw-gag; *d*, mouth-gag; *e*, sponge on holder; *f*, towels; *g*, pus basin; *h*, tumbler of sterile water and hypodermatic syringe (loaded); *i*, chloroform bottle; *j*, ether can; *k*, vaselin or albolene.

The basins and dishes should now be distributed. On the wash-sink are placed two hand basins. In one is poured alcohol, 50 to 95 per cent. The other is to be filled with sublimate solution, 1-1000, and in it are placed a hand-brush and an orange stick. In the sink, which should be scrubbed and scalded out, are placed another hand-brush and nail cleaner. The pot, tube, or bottle of soap is placed alongside; as are also basins containing a saturated solution of permanganate of potash and an 8 to 10 per cent. solution of oxalic acid, respectively, and the box of chlorid of lime and the crystals of sodium carbonate—if either of these methods of disinfection is to be used. On each side of the operating

table is placed another hand basin, and in it is to be made a sublimate solution, 1-2000. On the nurse's table are placed, if needed, two basins for rinsing sea-sponges, to be filled with boiled water or sublimate solution, 1-2000. Upon the instrument table are placed one or two shallow dishes, to contain alcohol for ligatures and sutures; one deep dish to contain sublimate solution, 1-500, for immersing ligature bottles or tubes, a sponge, and a piece of gutta-percha (which latter should previously be washed in cold soapsuds and rinsed in alcohol); one dish to contain sterile water or weak carbolic acid solution for cleansing instruments; the specimen dish; a tumbler or butter-dish to contain a little pure carbolic acid, if needed for cauterizing an appendix-stump; and trays to be filled with sterile water or carbolic acid solution, 1 per cent., if the surgeon prefers them to spreading the instruments out upon sterile towels. Lastly, a shallow dish

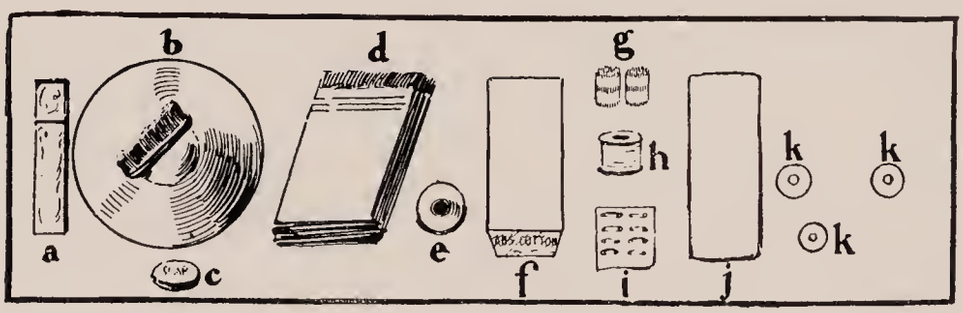


FIG. 16. Arrangement, in order, of accessories on mantel-shelf or other piece of furniture. *a*, razor; *b*, basin with brush and water for scrubbing patient; *c*, soap; *d*, two dry towels; *e*, alcohol bottle; *f*, absorbent cotton; *g*, bandages; *h*, adhesive plaster; *i*, safety-pins; *j*, binder; *k*, *k*, *k*, bottles of bichlorid tablets, carbolic acid, etc.

is filled with hot water for cleansing the field of operation. Upon the edge of the dish is placed some green soap, and in the water are laid a hand-brush or a mop of absorbent cotton, and a shaving brush. This dish is placed with the unsterilized supplies and alongside of it are arranged a razor, two dry towels and the unused alcohol—as shown in diagram 16. Here, too, may be placed a wide-mouthed specimen bottle, or jar, containing 2 per cent. formaldehyd solution.

The packages of towels, now thoroughly sterilized, are

lifted from the boiler and placed upon a clean dish or in weak sublimate solution to cool. The boiler is lifted from the range and placed in a corner of the room, where it can be drawn upon to make and replenish the solutions. The pitcher, lifted out and placed upon a sterilized towel, is used to dip out the hot water. The demijohn of distilled water* is placed nearby. Its cork is replaced by a plug of absorbent cotton, after wiping the neck and mouth of the demijohn with a sponge moistened in some antiseptic solution. In filling the basins it is to be remembered that neither unenamelled metal dishes nor water containing washing soda should be used in making sublimate solutions.

The instruments should now be "boiled" in water to which has been added a handful of washing soda. A fish-boiler makes an excellent sterilizer. While this is on the fire the assistant should uncover the gauze and sponge jars, and place the ligature tubes and the strip of rubber tissue in the basin of strong sublimate solution. Then he puts on his apron, cap, and mouth-cover, thoroughly sterilizes his hands and forearms, and dons his sterile gown.

The instruments are lifted out of the sterilizer and freed of soda by dumping them in the instrument trays or by pouring boiled water over them. If no instrument trays are used—and when the hands have been in oxalic acid the instruments will be found very slippery unless used dry—sterilized towels are lifted out of the package and spread out (handling them by their borders) for the instruments. Wet towels soak up infectious materials through their meshes, so they should be spread in sufficient thickness.

The instruments are now arranged neatly and systematically according to the order in which they will be needed. With a pair of forceps, sponges are lifted from their jar. One is dropped into the dish of sublimate solution, 1-500; another into the instrument-cleaning dish, and several into

* Even if this water, commercially prepared, is not absolutely sterile it certainly is sufficiently so for the preparation of antiseptic solutions, and its employment saves much time in preparing cold sterile water—time that in urgent cases cannot be spared.

the first sponge basin. Gauze sponges previously prepared, or cut now from the sterilized gauze, are laid upon a sterile towel on the nurse's table together with sponge handles. The latter should never be allowed to remain in the sponge basin if it contains sublimate solution, nor to touch the rim of the basin unless the latter has been boiled or is covered with a sterilized towel or strip of gauze. Packings, pads,

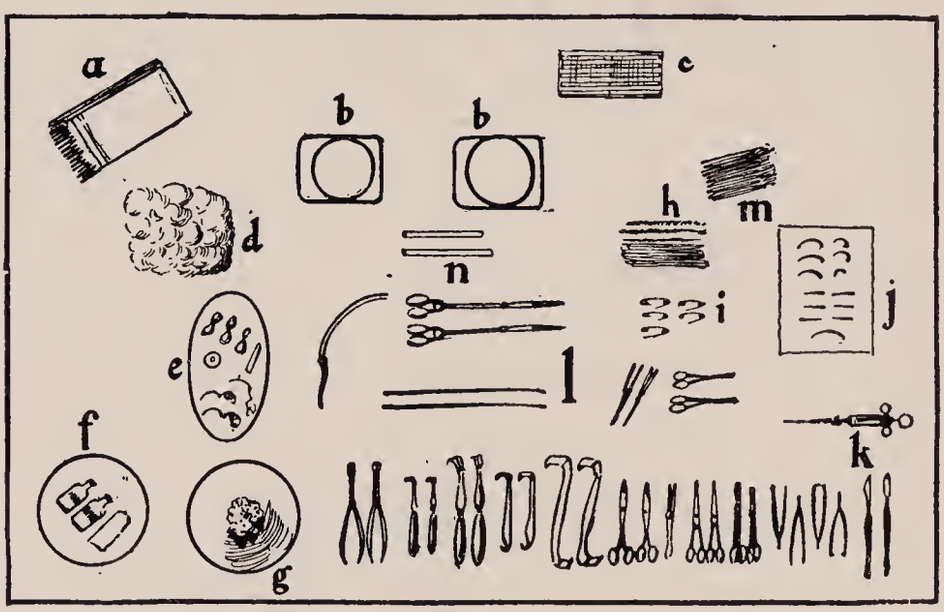


FIG. 17. Instrument table. *a*, sterilized towels; *b*, *b*, gauze jars; *c*, sterile adhesive strips; *d*, sterile absorbent cotton; *e*, dish of alcohol for prepared sutures and ligatures; *f*, dish of sublimate solution, one-fifth per cent., for ligatures in bottles and gutta-percha; *g*, basin with sponge for cleansing instruments; *h*, packings; *i*, sterilized safety-pins; *j*, needles; *k*, aspirating syringe; *l*, the other instruments arranged in the order in which they will be needed; *m*, pads; *n*, drainage tubes.

and drainage strips of appropriate size and number are cut and laid out on the instrument table. Some or all of the ligature- and suture-tubes are emptied into the shallow dish of alcohol. A supply of ligature strands is cut and arranged in the dish in little rolls. Two each of all the kinds of sutures that will be needed are threaded and placed neatly in the same dish.

With this arrangement of the instrument table, to be discussed again in detail, the assistant has completed his preparations.

Proceeding with dispatch and with such a system as is here outlined, and directing systematically those who may be at hand to help him, an assistant can in one or two hours

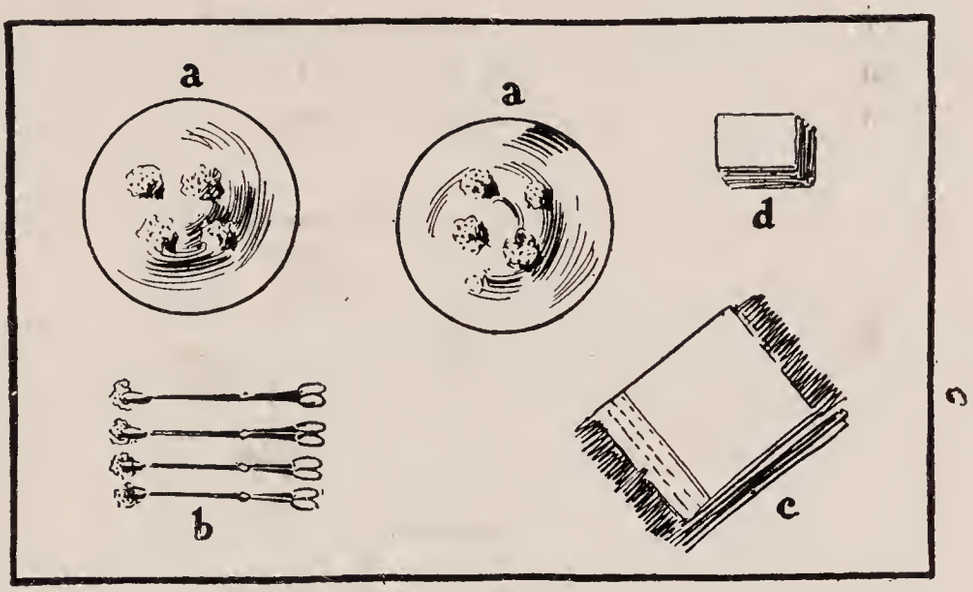


FIG. 18. Arrangement of table for second assistant (nurse's table). *a*, *a*, first and second sponge basins; *b*, sponges in sponge holders; *c*, sterilized towels; *d*, sterilized gauze, sponges and pads.

transform the parlor of a mansion or the kitchen of a tenement into an operating room equipped and ready for major aseptic surgery.

CHAPTER V.

PREPARATIONS FOR AN OPERATION.

THE PATIENT.

The preparation of a patient's digestive tract and the preliminary preparation of the field of operation concern the surgeon rather than the assistant, in private practice at least, and these details, important though they are, cannot logically be discussed here (see appendix I). Of those preparations immediately preceding an operation, however, a few words should be said.

Carrying a patient from bed to table requires considerable knack. Unless the individual is quite heavy he may often be more conveniently carried by one man than by two or more.

Figure 19 illustrates how this is accomplished. The patient's body is rolled upon the assistant's forearms (held in the manner shown), and against his chest which, thrown somewhat backwards, supports the weight without, as a rule, any great strain. If the patient is narcotized the head should be held low. The arms must not be allowed to hang down even for the short space of time elapsing before the table is reached.

Figure 20 illustrates the conveyance of a person by two men. Obviously the assistants should arrange themselves, in lifting the body, with reference to the side of the table or, after the operation, the side of the bed, to which the patient is to be restored.

It is well to place the patient at once in the position upon the table which he is to occupy, for shifting afterwards is awkward. The arms should be so disposed that they are not subjected to any pressure or stretching (see page 86).

If the operation is one that requires a preliminary lavage of the stomach that has not already been performed, the assistant should next give his attention to this (page 200).

It will save much trouble and discomfort if, before the field of operation is disinfected, the patient's clothing is rolled up far enough to prevent soiling and wetting. Thus, the night shirt and undershirt should be drawn well up to the shoulders posteriorly if a laparotomy is to be performed.



FIG. 19. Lifting and carrying a patient.

A blanket or sheet is then spread over the parts of the body not to be exposed for the operation, but the movements of the chest must not be impeded by heavy covering. A rubber sheet turned over the edge of the blanket will preserve it from soiling.

The field of operation must then be cleansed over a *wide* area. Even if the parts are not "hairy" they should be

shaved. Cleansing with green soap and hot water by means of a stiff brush or a soft cotton mop, as the operator may prefer, must be thorough in either case and performed with *clean* hands. Abundant lather is necessary, but not more important than a sufficiency of water, which it is well to apply from time to time during the scrubbing. Folds and crevices of the skin and especially the umbilicus (in abdominal operations) must be cleansed deliberately and



FIG. 20. Transportation of a patient.

thoroughly. For operations upon the foot the interphalangeal spaces should be vigorously rubbed with a strip of gauze or the edge of a towel dipped in soapsuds, and the nails should be trimmed and scrubbed carefully.

The parts are then wiped with one end of a dry towel, and with the other end (wrapped about the hand, barber fashion) alcohol is applied over the entire surface. This

may be followed by a wiping with ether. Iodoform-ether may be poured into the umbilicus and other crevices, where it forms a protecting film. The final cleansing of the field with $\frac{1}{5}$ per cent. sublimate solution or other antiseptic, should be left until after the assistant has again disinfected his own hands and the sterilized towels are spread. Disinfection of the patient's skin by chlorid of lime and carbonate of soda is as described below for the assistant's hands.

With the exercise of a little judgment the towels may be disposed about the field of operation economically and yet in sufficient number. They should be handled only by their edges. One is laid above, and another below the field and, without touching anything else in the manipulation,



FIG. 21. Arrangement of sterilized towels for laparotomy.

folded over the edge of the blanket underneath. It is well next to apply towels at each side, then transversely laid towels which, crossing over these, hold them from slipping off the table (Fig. 21.) Sterilized safety-pins may be used to catch them more securely, if necessary, but it must be remembered as a matter of aseptic accuracy, that

the points of these pins as they emerge from the under surfaces of the deepest towels are no longer sterile, and they should not be touched when the pin is closed. Enough towels should be spread (transversely) to cover most of the body and the table, leaving exposed for the operation a much smaller field than has been disinfected. Two layers of towels should be used in the immediate neighborhood of this field, and during the operation wet and bloody ones should be replaced or covered. A sterilized sheet, with an opening through which to operate, may be spread over the body in place of, or in addition to, the towels.

THE ASSISTANT HIMSELF; TECHNICS OF ASEPSIS.

In the familiarity with aseptic detail on the part of those who help, the surgeon must enjoy absolute confidence. An assistant who needlessly handles sponges, instruments, or dressings "because they are sterilized," or puts one unnecessary finger into the wound, or rests his hands upon his hips, "because his gown has been disinfected," has not yet learned that *the essence of asepsis consists in avoiding, as far as possible, contact with everything, sterilized and unsterilized.* Nor will he be thoroughly versed in aseptic principles until, to him, their every application becomes instinctive, their practise automatic!

Surgeons are often timid of allowing the family physician to assist in an operation solely because he may lack a familiarity with asepsis, for which a merely theoretical understanding cannot be substituted. To the acquirement of this practical experience even the occasional assistant should give his most conscientious attention.

Thorough preliminary disinfection is only a part, but a vital part, of aseptic technics. Before the "scrubbing up" is begun the assistant should don a rubber apron for the protection of himself, and a mouth-mask and cap for the protection of the patient. These latter can be fashioned from a piece of gauze stretched over the scalp, the ends being crossed beneath the occipital protuberance, brought forward

and spread over the nose, mouth (and beard) and tied at one side. The shirt-sleeves should be rolled up well above the elbows; and the scrubbing should also be beyond this level. It must be deliberate, vigorous and painstaking. Hot, running water is desirable and a rather stiff hand-brush, suitable soap, and a nail cleaner are essential. After a brief scrubbing of the nails these should be trimmed rather short and then receive a preliminary treatment with the orange stick



FIG. 22. The assistant "scrubbed up" and ready for the operation.

or other cleaner—under their edges and in the skin-fold about their borders. After a second, more prolonged, scrubbing, the nails should have a second cleaning with the stick. Then follows a vigorous, *systematic* scrubbing from finger-tips to elbows—first one arm and then the other, finger by finger, area by area. Such a scrubbing requires scarcely

less than five minutes for each extremity. Since the mouths of the sudoriferous and sebaceous glands, which are thrown into activity by the labor of an operation, contain many micro-organisms, Maylard suggests the following rational procedure: "The hands are submerged for from five to ten minutes in water as hot as can be conveniently borne. The effect of this is to dilate all the capillary vessels, as indicated by the redness of the skin, and thus excite into active secretion the two sets of glands. The sodden surface epithelium together with the secretions are finally removed by first massaging the hands under water, by making one rub the other, and then using some ordinary soap." *

After the scrubbing, the soap is washed from the skin with running water, and the hands and forearms are bathed for one minute in alcohol, 50 per cent.† to 95 per cent. Then follows their scrubbing for three minutes in a solution of bichlorid of mercury, 1-1000 to 1-2000, carbolic acid, 1-40, or lysol, 1-100. By pressing the pulps of the finger-ends forwards against the bottom of the basins, as advised by Weir, the spaces under the edges of the nails are opened to the entrance of the disinfecting solution. For additional disinfection, desirable if the assistant has recently been in contact with pus or other infectious material, the hands, after washing in alcohol and before washing in sublimate solution, may be immersed in a saturated solution of potassium permanganate. They are then rinsed in water (after allowing the excess of the solution on the skin to drip back into the dish), and the brown stain is removed by immersion in a strong solution of oxalic acid (8 to 10 per cent.)

For the bichlorid of mercury method there may be substituted disinfection by "chlorid of lime" and carbonate of soda. After the scrubbing with soap and water about a tablespoonful of the lime and one or two crystals of the soda are mixed in the palms with enough water to form a paste; and this paste is rubbed for five minutes into the nails and the skin of the hands and forearms, which are thus brought in

* Annals of Surgery, Vol. XXXV., No. 1.

† The weaker solution is the more penetrating.

contact with the free chlorin gas liberated by the mixture. The paste is then washed off with sterile water. "The objectionable odor which this leaves upon the hands for several hours may be removed by washing them in water containing about 10 per cent. of aqua ammonia, the chlorin uniting with the ammonia to form ammonium chlorid." *

Other modifications of the system of disinfection need no description in a work of this character. All methods need considerable time, and with none may the process be hurried. Often the surgeon, who has made his own preparations while the assistant has been cleansing the field of operation, is impatient to begin before the assistant himself has completed the disinfection of his hands. This should not cause him to shorten his toilet nor, indeed, should anything else be allowed to hasten him unduly—except, perhaps, the condition of the patient.

While an unsterilized gown (for which in emergency a clean sheet, properly draped about the body, may be substituted) may, of course, be worn during the disinfecting process, it is not until that process is completed that a sterile gown should be put on. In donning it the assistant should be careful that neither his hands nor his forearms touch any part of the gown that may have brushed against his body. Nor, if it buttons in the back, should he attempt to fasten the gown himself. In any event it is advised as a matter of routine that he dip his hands and forearms once more into the sublimate solution after the gown is on. Sleeves, separate or attached to the gown, are sometimes worn to prevent wound contamination by secretions from the forearms.

The employment of rubber gloves is the only method we possess of securing for the animate, the same aseptic condition as for the metal surgical tools. They constitute the next and final item in the assistant's personal preparation. If sterile talcum powder is not provided for drawing on the gloves in the proper way described below they may be slipped on under water, which balloons out the fingers, or in

* Palmer's "Surgical Asepsis," 1903.

a weak lysol solution, which is lubricating. That method is not to be recommended, however, for the imprisoned water macerates, and lysol irritates, the skin, and fluid dripping out of the glove at the wrist may carry with it into the wound sodden epithelium. Application of the gloves dry is the ideal method, and the technic is as follows: A salt- or sugar-" sifter " or perforated powder duster, filled with pulverized talcum or starch, is wrapped in a towel, and submitted to live steam for twenty minutes in a sterilizer, after which time the steam is turned off and the powder dried in the heat of the apparatus. The gloves are laid *flat* in a towel, which is then folded over them in a maner to both cover and separate them. This package is then enclosed in another towel and also sterilized by steam for twenty minutes. It is said that the rubber is less apt to adhere or tear if dried in the air rather than in the sterilizer.

The above is the only method of rapidly preparing dry sterile dusting powder, but the gloves may be prepared at the time of the operation by " boiling " them. If this is done in the instrument sterilizer they should be dropped in last and care should be taken that they are not placed in contact with sharp metal points. Two long dressing forceps are also to be sterilized. With these the gloves are to be lifted out by their fingers (to drain the water from them) and laid upon a double thickness of sterile towels. Their surfaces are patted dry with the upper towel, and dusted on each side with the talcum or starch powder. Then the gloves are turned inside out. To accomplish this, each one in turn is seized by the cuff with one of the forceps while the other forceps is passed into the glove and made to grasp and pull upon the " web " between two of the fingers.* The body of the glove is thus reversed, but not the fingers. If now the glove is seized with both the forceps at its cuff and rapidly twirled about its long diameter it will by its twisting seal up air within it, and pressure upon it (exerted through the towel) will cause the air to open out the " fingers " with a " pop." The now outer surface of the glove is patted dry. All this

* Collins, New York Medical News, August 20, 1904.

is accomplished without touching to the gloves anything but the forceps and the towel—both sterilized by heat.

Disinfected and dried by either of these methods, and lying on a towel, the gloves are thus to be drawn on:—The assistant dusts the talcum powder upon his dry hands, then, grasping the wrist margin of a glove *in a sterile towel or piece of gauze,* he slips it over the corresponding hand. The other hand is similarly clothed, lifting up the second glove with a *fresh piece of gauze* to pull it on. If the fingers need adjusting, this is done after both gloves are on or, at least, with still another piece of gauze over the opposite hand—never with the naked hand. Seizing or adjusting a glove with bare fingers defeats the very purpose of "the boiled hand"! This is self-evident; and yet the very frequent violation of the proper technic, even by those who are careful in other details, makes necessary the minute instructions upon the application of rubber gloves, just given.

Cotton gloves, if used at all, must be changed as often during the operation as they become wet. Gloves of either material should be of proper size, for if the fingers are too short, or especially, if they are too long the wearer's manipulations will be much hampered. The Murphy rubber dam used on the patient's skin serves a purpose similar to the rubber gloves. As a substitute Murphy has recently employed a solution of formalin-sterilized gutta-percha (4 to 8 per cent. in benzin or acetone) which covers the hands and the patient's skin with an impervious coating. It does not impair the sense of touch and is easily removed with benzin. For the patient, he recommends the acetone solution and for the surgeon the benzin. "The method of application to the [dried] hands and forearms is that of simple washing as with alcohol, care being taken to fill in around and beneath the nails. The hands must then be kept exposed to the air with the fingers separated until thoroughly dry. They may then be washed in alcohol, bichlorid, or any of the antiseptic solutions without interfering with the coating or affecting the skin. It wears off on the tips of the fingers if the operations be many or prolonged, when

another application may be made [to them] between operations "*

Were it not for its frequent breach by the untrained it would be unnecessary to state so obvious and elementary a rule as that, once disinfected, neither the forearms nor the hands should be allowed to come in contact with *anything* not sterilized; and that, if such an accident occur, immediate re-disinfection should be performed. But more than this, it is important not to handle even the sterilized articles unnecessarily. The gloved hand may become contaminated during an operation by contact with secretions from the patient's or the operator's skin, while the naked hand is always a possible source of contamination by its own secretions. Hence, *in the course of an operation the hands should be frequently washed in the antiseptic solution placed by the table.* Although it contains a contradiction, it is a safe principle for the assistant to follow to *have confidence in his aseptic methods; and yet to regard the hands, and every article that has once been touched, as possible sources of error.* In the constant application of such a rule he will develop the best technics of asepsis. Thus it will at once restrain him from touching his instruments needlessly, from lifting them except by their handles. It will remind him that instruments that were sterile when he handed them to the surgeon may not be so after they have been in the wound; and that therefore neither his fingers, nor forceps that have been used elsewise, should be introduced into the jars of ligatures and packings. He will not allow instruments or sponges to pass through too many hands. (Indeed an advantage of gauze sponges, quite as important as their adaptability to steam sterilization, lies in the fact that they are used but once and but one hand is needed to use them.) Similarly, he will hold packings taut above the patient's skin while they are being introduced.

These are but a few of the details of asepsis, to be ac-

* J. B. Murphy, Journal American Medical Association, March 19, 1904. Second communication, September 17, 1904.

quired by training and by the application of sound principles. The others are far too numerous to mention. There may be stated, however, for the assistant to take to heart, a few *"asceptic dont's:"*

Don't "scrub up" hastily—either the patient or yourself.

Don't forget to rinse your hands frequently during an operation.

Don't fail to re-disinfect after contact with unsterilized articles, by immersing in an antiseptic solution or by scrubbing again, if necessary.

Don't let your arms touch your gown, even though it be sterilized.

Don't touch anything needlessly.

Don't pass instruments or sponges through too many hands.

Don't put your finger in the wound if an instrument will do as well.

Don't put either in the wound without reason.

Don't expose too large a "field of operation."

Don't neglect to keep the area about the wound (and in the wound) clean and dry.

Don't sponge *into* the wound.

Don't allow sutures, gauze or instruments to drag over uncovered skin.

Don't rest your hands on the patient's skin.

Don't allow your head to come close to the wound.

Don't allow your head to rub against the operator's.

Don't spread your arms over the patient's body.

Don't allow your elbows, or the operator's elbows, to touch instruments on the patient's body.

Don't fail to watch constantly for errors in aseptic technic; don't hesitate to call attention to them at once.

Don't talk!

CHAPTER VI.

THE ANESTHETIST.

The assistant who administers the anesthetic shares with the surgeon, to a far greater degree than does any other of those who help at an operation, the responsibility for the welfare of the patient; he occupies towards the surgeon a peculiar relationship—a relationship which in the conduct of their work should be mutually recognized.

Only a grave emergency justifies the administration of a general narcotic by one who has not had tuition, and at least reasonable experience. For this reason and because detailed instruction can be found elsewhere, it is intended here to deal, for the most part, with some practical points not always emphasized in text-books.

The choice of the anesthetic is usually made by the operator. Nevertheless, since it is of the greatest importance for the narcotizer to appreciate, so we may logically review, the effects upon the various organs of ether and of chloroform, and the chief indications and contra-indications in the use of each. Chloroform is a cardiac depressant, ether a cardiac stimulant. Ether is therefore, generally speaking, safer and except for those who are expert, it is the anesthetic of choice when no contra-indication to its administration is present. Although, in the author's experience, respiratory paralysis is far more frequent during chloroformization than is cardiac failure, still in those cases that eventuate fatally the determining phenomena are usually cardiac. However, while chloroform is therefore inadmissible in the presence of an active heart lesion, nevertheless an old endocarditis, well compensated and without marked circulatory disturbances, does not interfere with the administration of that anesthetic when, for other reasons, ether is ineligible. It must be re-

membered too that cardiac failures during chloroformization, being more striking (and more tragic), are more often reported than fatalities from pneumonia or suppression of urine subsequent to ether narcoses. Ether is a pulmonary irritant and congestant; and the weight of evidence seems to be in favor of its being also a renal irritant. For operations upon the lungs or kidneys, or in the presence of disease of these organs, chloroform, therefore, should ordinarily be selected. While, with skill, ether can be administered to very young subjects by the "open" or "drop" method without inordinate irritation of their sensitive air-passages, chloroform is generally preferable for infants and small children; as it is also for patients of advanced years, because of the greater danger of pneumonia and, if arteriosclerosis be present, of cerebral trouble from the use of ether. If advanced arteriosclerosis exists, both ether and chloroform are dangerous drugs, and either must be employed with great caution. Ether causes cerebral congestion and is not to be preferred for intracranial operations. For the same reason, and also because it can be administered with less interference to the operator's manipulations than can ether, chloroform is to be selected for operations upon the mouth and throat. An important exception to this rule exists in anesthetization for the removal of adenoid growths and enlarged tonsils. In these cases, ether is probably safer; but accumulating evidence indicates that in the presence of the *status lymphaticus,* of which adenoid growths are sometimes only an expression, ether, as well as chloroform, is *distinctly dangerous.*

When it is important to minimize the vomiting after operation, chloroform is ordinarily to be preferred. As the malaise after the employment of ether is usually more lasting, so its initial effects (unless these be eliminated by employing the gas-ether sequence) are more disagreeable, than those of chloroform, which induces unconsciousness more speedily as well as more pleasantly. This is important in selecting an anesthetic for a patient who is timid or sensitive, and it is even more important if he be alcoholic.

Anesthesia mixtures (the A. C. E. and C. E. mixtures* so popular in England, Billroth's mixture,† the Schleich mixtures ‡ exploited seven years ago, "Anesthol," †† etc.,) occupy in a general way, in regard to safety and to effects, a position between those of chloroform and of ether, but they may, of course, produce the ill-effects of either. Used by some surgeons more or less as a routine, these mixtures are by others employed in preference to chloroform in those cases in which there is an objection to pure ether, *e. g.*, the great age or youth of the subject, the presence of a bronchial, pulmonary or renal affection, etc. The mixtures are sometimes useful as an introduction to chloroform or ether ("anesthesia sequence"), and it cannot be denied that occasionally there is met a subject who cannot be satisfactorily narcotized by either chloroform or ether, but who reacts well to the skilful administration of one of their mixtures.

All the foregoing considerations impress the value to the anesthetist of personally studying the heart and the pulse, of inquiring into the condition of the lungs, the kidneys and, in suspicious cases, the lympathic system, of learning the patient's temperament (and of removing false teeth or other loose objects from the mouth), before the narcosis is started. Nor should it be begun until he has provided himself with one or two towels and the instruments referred to in a previous chapter—screw-gag or hardwood wedge for forcing

* A. C. E., alcohol, 1 part ; chloroform, 2 parts ; ether, 3 parts. C. E., chloroform, 2 parts ; ether, 3 parts. For a description of the uses of these mixtures, and as an excellent text-book upon the entire subject, the reader is referred to Frederick Hewitt's "Anesthetics and Their Administration."

† Alcohol, 1 part ; chloroform, 3 parts ; ether, 1 part.

‡ Three separate combinations of chloroform, ether, and petrolic ether (benzin).

†† A chemical combination of ethyl chlorid with a "molecular solution" of ether and chloroform, the liquid having a boiling point closely approximating the temperature of the body; ethyl chlorid, 17%; chloroform, 36%; ether, 47%, by volume.—Willy Meyer, Journal American Medical Association, February 28, 1903. Manufactured by Chas. Cooper & Co., New York.

open the mouth; Denhard or other mouth-gag; tongue-forceps; one or more throat swabs; and a syringe loaded for hypodermatic stimulation—all of which should be within easy reach, but out of the patient's sight.

In those cases in which an emergency demands the administration of a general anesthetic without previous preparation of the patient a preliminary gastric lavage may be desirable.

It is conducive to cleanliness to confine the patient's hair in a thin rubber cap or in a towel. One of the long edges of the towel encircles the head, passing just below the occipital protuberance, just above the ears, and across the forehead, where the overlapping ends are caught with a safety pin. The body of the towel is brought forward over the scalp, and the two loose ends folded together and secured at the forehead with the same pin. A few turns of a bandage may be used, instead, to hold the cap.

A preliminary hypodermatic injection of morphin (gr. 1-6—gr. 1-5 of the sulphate) may be made when the operation is apt to be prolonged, or when the quantity of the narcotic required should for any reason be minimized. Chloretone, gr. x-xv, by mouth, has also been recommended. It is usually desirable, and sometimes quite imperative, to administer morphin (gr. 1-6—gr. 1-4) to alcoholic patients. It diminishes the intensity and duration of the "excitement" they usually exhibit, and simplifies a narcosis that, at best, is apt to be difficult and trying. An injection of atropin sulphate, gr. 1-100, prevents excessive mucus secretion from ether narcosis. When morphin or atropin is thus used, its effect upon the pupils must be taken into account in watching the eye signs. Both pupils should be inspected before the narcosis and during its induction, so that the anesthetist may learn the effects upon them, in the individual case, of increasing and decreasing the doses.

It is important to secure the confidence of the patient from the outset, to inform him of the sensations he will experience, and to instruct him to take deep breaths—all before any narcotic vapors are approached to his face. The mask

should at first be held several inches away and then brought gradually closer to the nose. A brief cessation of respiration in the first stage, more common during etherization than in chloroform narcosis, does not demand a removal of the mask, as it does when occurring during profound anesthesia but, on the contrary, it requires that the mask should be held in position so that the patient will receive with the first returning inspiration, which is usually deep, a needed dose of the vapor.

The stage of excitement is frequently absent (objectively, at least), often brief, and only occasionally troublesome; and slight restless movements should not be restrained. Alcoholics become pugnacious, however, and large, plethoric individuals may be difficult to handle. To restrain the patient then requires one or more assistants to hold the wrists and knees firmly against the table, while the anesthetist grips the head between his forearms. Pressure upon the chest must be avoided. An injection of morphin at this stage is very helpful. If ether is being administered the mask should be freely saturated and held firmly against the face, all air being excluded. Chloroform, too, may be "pushed" somewhat but, unlike ether, should never be "crowded." Though the patient be struggling violently it is important that someone should watch the pulse, for even in this stage of incomplete narcosis dangerous collapse may occur—just as occasionally it occurs when operative procedures are undertaken during insufficient anesthesia. After several deep inspirations the subsidence of the violent tremors, glottic spasms and cyanosis marks the termination of the stage of excitement; but the administration of the anesthetic should not be remitted until the second stage* is safely inaugurated. The appearance of stertor (if it has not already been present in these individuals) also marks the advent of deepening narcosis.

At this stage it is important to keep the air passages freely open, for which purpose it is well to remove the pillow and to extend the head—whether it be held sideways or in the

* "Third stage" of Snow, Hewitt, and other authors.

median line. The position of the arms also must be carefully attended to.

When the site of the operation does not interfere, it is best to place the arms alongside the chest, with the forearms folded lightly across the lower thorax where they may be held by rolling the bottom of the patient's shirt over them. A paralysis of one of these members after general anesthesia is usually attributable to its having been allowed to lie in a vicious position. Such paralysis is very distressing, for it is always of long duration and is sometimes incurable. For its occurrence the anesthetist must hold himself solely responsible; for its prevention, therefore, he should afford his constant watchfulness.

Discussing the anatomical factors in the production of narcosis paralyses, in connection with the report of a bilateral brachial palsy occurring in a patient upon whom the author operated for appendicitis, he deduced these practical rules: *

"1. The care of the arms is as important a part of the anesthetist's duty as is the administration of the narcotic. They should never be allowed to hang over the edge of the table. This position threatens the musculo-spiral nerve by pressure, and the entire plexus by stretching.

"2. Rotation and superextension of the head should be exercised only while emergency requires it.

"3. Prolonged pressure of any kind should be avoided, be it that of an assistant's hand or body, or that of a harness. When used, the shoulder-strap of a leg-holder should pass over the tip of the shoulder, or over a large pad of cotton wool on the neck; or, best of all, should be held by an assistant (the anesthetist can usually spare a hand to pull the strap up from the body from time to time). It should be remembered that this apparatus has occasionally caused paralysis in a leg, as in one of Garrigues' cases.

"4. The common practice of drawing the arms alongside the head, however much it may contribute to the convenience of the anesthetist and the comfort of the operator, is a bad one and should not be tolerated. Remembering that in

* New York Medical Journal, April 27, 1901.

some of the cases reported *the arms were lying alongside the body during the operation,* the safest rule to follow is to *avoid allowing either arm to remain more than a few minutes in any one position, however innocent that position may appear to be.*"

Paralysis of a leg is less apt to come from the pressure of a strap itself than from the pressure of an assistant's body upon the flexed extremity. While the anesthetist is not responsible for such a fault he is in a position to call attention to it. Nor should his watchfulness cease when the patient is removed from the operating table. He should see that none of the extremities lies in a constrained position when the patient is returned to his bed. (That someone of experience should remain at the bedside until the patient is " out " of the narcosis needs here no more than the passing mention.)

In addition to the arms, the anesthetist should take constant note of the patient's color, pulse, respiration, and reflexes.

The Color of the lips, of the lobes of the ears, of the escaping blood, is an index to the extent of the oxygenation in the lungs. Slight cyanosis, especially during etherization, does not call for treatment if present from the beginning. Deeper cyanosis is an indication for freeing the air passages if they are obstructed by mucus or by the falling back of the tongue, for the allowance of more air, or (more particularly in the presence of other signs) for the withdrawal of the anesthetic.

The Pulse should be watched constantly and *by the anesthetist himself.* This may be conveniently done at or just below the point where the facial artery passes over the horizontal ramus of the lower jaw (at the anterior border of the masseter muscle), where the temporal artery crosses the zygoma, at some point along the course of the internal carotid, or by holding the upper lip between finger and thumb (superior coronary branch of the facial artery). Frequent reference to the radial artery is helpful, too, and, indeed, the radial pulse may be watched throughout—and without dragging the arm alongside the head to accomplish it.

Acceleration of the pulse-rate is frequently to be noted during the first stage, but in the second stage—of chloroform narcosis more especially—the pulse usually resumes about its normal rate.

Enfeeblement of the pulse is a matter of concern, but not necessarily of alarm. It may have no other significance than an individual reaction to the narcotic, disappearing when the patient is allowed to "come out"; and a skilful anesthetist often carries a patient safely through a prolonged, deep narcosis, with a pulse that is throughout of poor quality. A pulse that is both rapid and feeble, however, more especially if the symptom is a progressive one, requires treatment. It must be decided whether it is the result of shock, loss of blood, insufficient aeration of the blood, or the cumulative effect of the anesthetic. Accordingly it will call for haste in the operation, stimulation, more air, change of anesthetic, or withdrawal of anesthetic—or a combination of these.

Rapidity and enfeeblement of the pulse often appearing rather abruptly, may, however, have a significance quite diffierent from these, viz., that the patient is "*coming out,*" or (and) that he is about to vomit. Nice judgment is therefore needed to determine which of two opposite things is required—more anesthetic or less anesthetic. If the narcotizer informs the surgeon that the patient's condition is bad—which he should always do when such is the case, he may disconcert the operator unnecessarily—which he should never do, and may find, to his embarrassment, that the patient reacts vigorously the next moment. If he *assumes* that the patient is coming out and pushes the narcosis, he may administer a lethal dose to an already poisoned heart. If the condition of the reflexes does not help him in deciding which course to pursue, he should withdraw the mask and await further developments. *At no time should an anesthetist administer a single dose of the vapor without having an accurate appreciation of how far the patient is "under," and in what condition he is.* Haphazard anesthetization is bad anesthetization; and guesswork is never excusable.

The Respiration, which may be jerky and irregular or rapid, in the first stage, should be regular and slow in the second stage of narcosis, when it is usually more or less stertorous. Blowing of the cheeks is in most cases a sign of deep narcosis. Flapping of the soft palate gives a stridulent or sonorous character to the stertor, which latter, being due in part, at least, to falling back of the tongue, can usually be overcome by lifting the jaw forward. This is accomplished by pressure of the middle finger against the angle of the inferior maxilla,—the forefinger is thus left free to feel the facial pulse, and the thumb to test the eye reflexes.



FIG. 23. Administration of chloroform. The jaw is being held forward by pressure of the middle finger of one hand; the index finger is on the facial artery and the thumb is testing the conjunctival reflex. Note also the towel about the head, which is extended on a flat pillow; and the unconstrained position of the arms and hands.

Supporting the jaw on one side only will usually suffice, and it is advisable to change occasionally from one side to the other to obviate the soreness which otherwise often results from continuous pressure upon one spot. The jaw may also be held forward by catching the lower incisor teeth in front of the upper ones (if they be large and strong), and it can be maintained in this position by light support with one finger under the chin. If extension of the jaw does not

entirely overcome the stertor, nothing further need be done, provided neither cyanosis nor other sign indicates inefficient respiration; and it must, of course, be remembered that during etherization engorgement of, and increased secretion by, the pharynx are themselves causative of stertor. If, however, it is evident that the base of the tongue is still seriously obstructing the air passage in spite of the jaw ex-



FIG. 24. Sponging mucus from the pharynx. Mouth-gag in position.

tension, then a screw- or wedge-gag should be pried into the mouth, between the upper and lower molar teeth, and the tongue drawn forward by means of forceps. For prolonged traction on the organ this bruising instrument should be replaced by a stout guy-suture passed transversely through the tongue near its middle.

The pharynx must be kept free of mucous accumulations. To reach the cavity a metal mouth-gag is introduced between the jaws, after they are forced open with the screw or wedge, and the handles of the instrument approached. A sponge firmly secured in a carrier is then passed well down in the pharynx, the walls of which are cleansed from below upwards by imparting a spiral movement to the sponge. This

is repeated until the throat is clear. Accumulations in the pharynx of mucus, blood or vomitus, when the operation is concluded and the patient is reacting, should not be wiped out, both because the returning pharyngeal reflexes will induce their expulsion and because the irritation of the sponge is apt to provoke vomiting.

Sudden stoppage of the respiration, like enfeeblement of the pulse, is not necessarily ominous for, like the pulse sign, it may merely presage reaction. Often extension of the jaw, strong pressure upon the thorax or slapping the chest with a wet towel may be all that is necessary to restore respiration. If no other serious sign is present the anesthetist may safely wait a brief period for the breathing to return. If it does not, however, then no further time should be wasted with tentative measures, but artificial respiration (Sylvester's) should be inaugurated at once. It should be vigorous, systematic and *slow* (synchronous with the manipulator's respirations). The upward movement of the arms should be a steady one; the downward movement should be followed by strong pressure upon the sides of the chest. Atropin may arouse the medullary centre, and since the heart action will soon flag if breathing be not restored, stimulants should not be long withheld. When the heart begins to fail, strong thumb pressure or percussion over its apex should be practiced, and repeated about eighty times a minute. Laborde's tongue traction may be performed synchronously with the artificial inspiratory movement. Dilatation of the anal sphincter is sometimes very useful. Elevation of the foot of the table and the application of hot blankets are helpful adjuvants. Finally, faradaization of the phrenic nerve and insufflation of the lungs may be tried if the apparatus are at hand. None of these methods, however, is as reliable as the artificial respiration, which should be persisted in for hours if necessary—until rhythmic breathing is restored, or until the faintest heart flutter has long since ceased to be heard and other signs of death are unmistakably present.

The Eyes. Although the *conjunctival reflex* is most active

over the cornea (corneal reflex), that part of the eye should not be touched since this risks the production of an ulceration. The sclera may be touched frequently without injury but to elicit the conjunctival reflex it usually suffices to lightly and quickly lift the edge of the upper lid—which movement at the same time exposes the pupil for inspection. The liveliness of the conjunctival reflex is less important than the variations in its activity. While generally a feeble contraction in the orbicularis when the conjunctiva is touched, indicates a relatively deep narcosis, and a vigorous contraction indicates a relatively light narcosis, the response is not the same in all individuals. Thus it is sometimes to be noted that a patient is quite relaxed and anesthetic even though the conjunctival reflex is fairly active; and, per contra, another patient may unexpectedly react when this reflex is absent, and ocasionally when, also, the respiration is stertorous, and the cheeks "blowing." *Changes in the reactibility* of the lid are, however, very useful as indices to fluctuations in the depth of the narcosis.

The same remarks apply to the size of the pupil. Although it is usually moderately contracted during the second stage of the narcosis (more especially of chloroform narcosis), it is often dilated or of medium size. By studying the pupil for a few moments, however, the anesthetist learns its individual reactions, and by the *changes* it undergoes he may be able, unless much morphin has been injected, to gauge very accurately the depth of the narcosis and to conduct its administration accordingly. Thus an alteration from moderate dilatation to contraction frequently means deepening of the narcosis, and *vice versa.* If extreme dilatation of the pupil occurs suddenly during deep narcosis, it tells the anesthetist that he has allowed his patient to approach too near the danger line! In light narcosis the pupils may dilate reflexly from operative manipulation. Disappearance of the *pupillary reaction* to light indicates a dangerously profound narcosis and calls for withdrawal of the anesthetic until the reflex is re-established.

By thus studying the color of the skin, the pulse, the re-

spiration, and the eye reflexes the anesthetist is enabled to secure and maintain a degree of narcosis required by special cases. Conditions present before operation, or arising during anesthesia, may make it necessary to give the patient but little of the narcotic, viz., to secure unconsciousness without complete relaxation, or relaxation without profound narcosis. During a herniotomy it may occasionally be helpful to allow a patient to "come out" sufficiently to strain into view a sac that has slipped back into the abdominal cavity. Operations upon the anus require deep anesthesia,—stretching of the sphincter ani or the cervix uteri may elicit a loud snort or a vigorous movement of the legs, even when the other reflexes are abolished.

Stimulation. For bolstering a flagging heart strychnin or (and) whiskey (or brandy) may be injected hypodermatically in doses, for adults, of gr. 1-30 and 30 minims, respectively, which may be repeated. Digitalis (♏x of the tincture) is very serviceable, as are caffein (*e. g.*, the salicylate or benzoate of caffein and sodium, gr. ii), adrenalin and nitroglycerin. Small doses of morphin (gr. 1-8—gr. 1-6) possess the double advantage of stimulating and steadying the heart and of reducing the quantity of anesthetic necessary to maintain narcosis. To combat shock occurring during operation the assistant may order the introduction, by means of a piston syringe, beyond the internal sphincter ani, of

Tinct. digitalis	♏xx
Whiskey	℥i
Salt	ʒss—ʒi
Water (at 110° F to 120° F)	℥viii—Oi

In the event of collapse, large doses of strychnin (gr. 1-20 —gr. 1-10) and of whiskey, are indicated. Ether, ʒss, in which may be dissolved a grain of camphor, may be injected for rapid, though transitory, effect. Finally intravenous infusion may be required.

Vomiting. Threatened vomiting may usually be avoided by "pushing" the anesthetic. But vomiting that is inevitable

or actual demands that the mask should be removed, the head turned strongly to one side (away from the field of operation, preferably), and the jaw pushed well forward. Steady pressure upon the left phrenic nerve in the space between the two heads of the sterno-mastoid muscle may be tried as a means of controlling emesis. Not until the vomiting has ceased and the mouth and pharynx are cleansed, should the anesthesia be resumed.

Individual Methods of Administering the Various Anesthetics.

Chloroform. In emergency an ordinary handkerchief, or the corner of a towel passed through a safety pin (as suggested by Lister) may be used as a mask, or better than these, as a makeshift, a piece of gauze stitched over a large tea-strainer. Ordinarily there is employed an inhaler, such as that of Esmarch or Laplace, or the very excellent one recently devised by Yankauer* (appendix, fig 1.) Upon these is stretched a piece of balbriggan or unbleached muslin, or a double thickness of surgical gauze. Lacking a regular "drop bottle," one may be devised as described on page 62 or, probably better, "a simple drop bottle is made by cutting two V's in a cork in opposite sides. A piece of absorbent cotton long enough to reach the bottom of the bottle is placed in one V, and allowed to protrude about an inch; the other V serves for an air vent. The rapidity of the drops may be regulated by inclining the bottle, though it should never be tipped enough to allow the anesthetic to run from the opening in the cork. The size of the drops may be regulated by twisting the cotton wick fine or coarse. Another method which works equally well and does not spoil the cork is to place a match in the neck of the bottle beside the cork, so that it will not fit too tight, and then place in the cotton wick." †

* New York Medical Journal and Philadelphia Medical Journal, June 4, 1904.

† B. F. Stevens, American Medicine, August 13, 1904.

When chloroform is administered where gas or a grate-fire is burning, it is especially important that the room be kept ventilated, for otherwise it becomes filled with phosgen (carbon oxychlorid), a very irritating gas produced by the decomposition of the chloroform vapor.

The patient's eyelids, nose, cheeks, lips and chin should be anointed with a thin layer of vaselin or albolene (or even butter) to prevent burning—a precaution that is unnecessary when the Yankauer mask is used. Should chloroform drop on the unprotected parts of the face, however, it will do no damage if immediately wiped off. If chloroform (or ether) fall into the eye, the conjunctival sac should be promptly irrigated with a little warm water. The chances of such an accident are minimized by protecting the eyes with cotton pads or a folded towel.

Ideal chloroformization consists in allowing the drug to fall, drop by drop, upon the mask, at such regular intervals throughout as will just maintain, unfluctuating, the desired narcosis; and in ceasing the administration at such time as will allow reaction as soon as, but no sooner than, anesthesia is no longer needed. Practically, however, this method is approached, but seldom actually carried out. Variation will usually be found necessary, both in the rate of administration and in the quantity administered from time to time; and thus, too, the drug will be withdrawn altogether, now and again, for long or short periods, as the profundity of the narcosis indicates.

With the exercise of skill and patience, children may be chloroformed while sleeping. When awake they invariably cry when they smell the vapor; as the crying subsides it is wise to withdraw the mask for a short time, for it is just at this stage that children may otherwise inhale an overdose.

For operations upon the head or neck, the anesthetist should disinfect his hands, use a sterilized mask, and surround the chloroform bottle with sterilized gauze. He should see to it, here, that no instrument is allowed to lie on the exposed (or unexposed) cornea. For operations about the mouth the mask may be replaced by a long, curved, metal

tube, one end of which is introduced into the faucial opening and the other end connected by rubber tubing with the exit pipe of an atomizer. By means of the hand bulb air is bubbled through chloroform in the flask, and the vapor of the narcotic is carried into the patient's air passages. The same device may be used for administering chloroform through a tracheal wound or, less elegantly, a thin pad of gauze held in a sponge carrier in front of the tracheal opening may be used to carry the drug.

Ether. There is no need to protect the face with vaselin, for the skin does not burn from contact with ether. Ether vapor is heavier than air and highly inflammable, for which reasons no lamp, gas jet or fire should be allowed to burn in the room except above the level of the operating table

Open ("Drop") Method. This is conducted much as is chloroform administration, an open inhaler being used. Since ether evaporates very rapidly, however, several thicknesses of gauze should be stretched over the mask, and it is also advisable to use an inhaler like that of Laplace, in which much of the gauze is covered with a metal cap, or to stitch over the gauze a piece of oiled silk, leaving exposed a space in the center about the size of a silver dollar. The ether is applied more freely than is chloroform, *i. e.,* the drops are made to follow one another more closely.

The open method of etherization may be used for adults, but is especially applicable to children.

Closed Method. The towel cone described on page 63 answers all practical purposes. Half an ounce of ether, more or less, is poured on the cotton, gauze or sea-sponge in the apex, and renewed as it evaporates. The Allis inhaler (appendix, fig. 2) permits the introduction of the ether from above when the anesthetist does not wish to lift the mask from the face. Through the same opening air is drawn with each inspiration, unless the rubber sides are folded over the top. The "excitement" of the first stage of ether narcosis is usually more marked and more prolonged than in chloroformization. Towards the end of this stage a general tremor is oc-

casionally noticed. Occasionally, too, a vivid roseola makes its appearance about the face, neck and chest. It comes early in the narcosis, and lasts but a few minutes. While in chloroformization free admixture with air is imperative at all times, during etherization air is usually needed (in relatively smaller amounts) only from time to time. And so here, too, remissions in the administration are called for as cyanosis, stertor, or the profundity of the narcosis may indicate. If ether is used during an operation upon the head, its administration may be conducted under the covering of a sterilized towel.

Hewitt describes the use of the Allis inhaler and the towel cone as constituting the "Semi-Open" Method of etherization, and limits the Closed Method to the employment of Clover's, Ormsby's, Bennett's or other apparatus that includes a rubber bag from which the patient breathes his own exhalations mixed with fresh ether vapor. The modus operandi of these excellent apparatus is simple, and needs no special description here.

Anesthesia by ether may be induced more quickly and more pleasantly than by chloroform, if preceded by the administration of nitrous oxid gas. For this purpose a

Gas and Ether apparatus, such as Bennett's (appendix, figure 3), is desirable. By an arrangement of graduated stops, ether vapor is slowly introduced into the face-piece as the patient "goes under" the gas, which latter is gradually withdrawn, the gas reservoir being replaced by an empty rubber bag for collecting and returning the expired gases. Traps are provided for the admission of air in regulated volume.

Chloroform and Ether mixtures. These are always to be administered upon an open mask, preferably one arranged as described for the drop method of etherization. It must not be supposed that any of these mixtures eliminates entirely the dangers of either of their chief components, and "the claim that the administration of [these] mixtures requires less care and less watchfulness than the use of chloroform or ether is, to say the least, vicious in purpose and re-

sult."* It was the author's experience with the Schleich mixtures that the eye signs during narcosis are not very reliable guides.



FIG. 25. Administration of gas and ether by means of a Bennett apparatus. Head turned to one side. Jaw extended. Forearms at sides of chest. Anesthetist's forefinger notes facial pulse.

Nitrous Oxid narcosis, as, indeed, the administration of all general anesthetics, should be preceded by an examination of the heart and the mouth. Unlike chloroform or ether it may be "pushed" from the start, the face-piece of the apparatus being crowded down snugly and all air excluded, after a preliminary whiff or two of mixed gas and air. If the patient be instructed to hold one arm up, the arrival of analgesia, if not of anesthesia, will be marked by the falling of the extremity. Relaxation is not a purpose of this narcotic, and marked rigidity often accompanies complete unconsciousness. The occurrence of violent coarse tremors or spasms, however, is an indication for the prompt allowance of air. Cyanosis is the

* Mt. Sinai Hospital Reports, Vol. 1, 1898

rule, but it should not be allowed to pass beyond the point of duskiness, and certainly should not be long maintained at deep blueness, of the features. When the narcosis is prolonged, or the cyanosis becomes deep, the administration should be remitted, and the patient allowed to breathe air for a brief period. That asphyxia is not essential to the production of anesthesia by laughing gas is shown by the fact that, by means of

Gas and Oxygen, admitted to the face-piece of an apparatus in regulated proportions, from separate cylinders, a sufficiently deep narcosis may be maintained, for an hour if necessary, without the appearance of any cyanosis.

Ethyl Chlorid general narcosis has such wide usefulness in minor surgery and, by reason of the greater portability of the apparatus, possesses so obvious an advantage over laughing gas that the simple technics of its induction are well worth learning. Like nitrous oxid it does not usually secure muscular relaxation. In spite of this the writer has, without much difficulty, performed complete stretching of the sphincter ani and clamping and cauterization of internal hemorrhoids, upon a slender adult anesthetized by ethyl chlorid. Various masks have been devised for its administration. That of Breuer has an inspiratory and an expiratory valve, the former of which opens from a receptacle for gauze or absorbent cotton, upon which the ethyl chlorid is poured. A very simple mask is that of Ware (appendix, figure 4). It consists in a short tube, about one inch in diameter, one end of which is covered with two or more layers of gauze and thrust into the opening of the simpler, valveless form of face-piece sold by the S. S. White Dental Co. for nitrous oxid apparatus. This mask may be improvised from a funnel, or a cone of heavy cardboard which, however, must be fashioned to fit the face closely. The ethyl chlorid is sprayed into the mask from a glass tube sold originally for local anesthesia ("kelene"). For economy and convenience of administration there should be selected only those tubes that have automatic, spring releases; and the patency of the fine opening into the tube should be tested when the purchase is made. By

pressure on the spring the ethyl chlorid is sprayed through the tube and on the gauze intermittently, viz., with each inspiration. The expired air soon freezes upon the gauze; but the frost should not be allowed, by reason of too rapid administration of the drug, to close entirely the opening into the face-piece.

Flushing of the face, muscular spasms and a brief dilatation of the pupils are followed, when narcosis appears, by diminution of the contractions of the muscles, decrease in the size of the pupil, and somewhat stertorous breathing. The pulse rate is accelerated. The pupillary signs are, in general, like those in chloroform narcosis, but are less constant. If the anesthesia is prolonged the administration of the drug may be remitted from time to time. These remissions must be for very brief periods only, however, for the patient "comes out" as quickly as from laughing gas, and with as little after-effect. (Vomiting occurs sometimes; nausea is a more frequent sequel, but usually does not last long.)

Ethyl Bromid. This anesthetic is less satisfactory than ethyl chlorid, and probably less safe. It is very important with the bromid, and indeed with the chlorid, of ethyl, to secure a pure preparation. A towel-cone or Ormsby inhaler may be used, about a teaspoonful of the drug being poured on the sponge. The mask is applied firmly to the face until the patient has inhaled a few times, after which some air is admitted. Ethyl bromid does not seem suited for intermittent administration, nor for any operation that is not quite brief, *e. g.*, those that can be accomplished during, or just after, the administration of a single "dose." It induces rapidly a narcosis that is as quickly recovered from. There is usually no struggling. Respiration is free, sometimes slightly snoring. The pulse rate is accelerated, as a rule. The conjunctival reflex may become lost or may remain quite active; the pupil usually dilates. Unless the administration is very brief, it is followed by severe headache and vomiting.

FOR OBSTETRIC NARCOSIS chloroform is most generally useful, although ether is not ineligible for many operations.

The manner of administration in *normal labors* depends upon whether the purpose is to alleviate pain, to retard expulsion, or both.

In the second stage of delivery, before the head is at the outlet, a "whiff" of chloroform may be administered to "take the edge off" a pain. For this purpose the liquid is poured rather freely upon a mask or handkerchief, with the advent of a pain, and withdrawn as the pain passes off. When the head is stretching the vulvar outlet the pains become more and more frequent and severe, and so the administration of the chloroform is made more continuous and the patient is brought moderately "under." Thus the perineum is allowed to distend gradually, and the head is delivered by the accoucheur, slowly and without injury to the maternal soft parts. When the head is born the chloroform should *not* be withdrawn, for the sudden onrush of the shoulders that would follow may rupture a perineum that has been carefully guarded; and even the infant hips occasionally do damage in passing. When the child's body has been delivered, however, the mask should be removed, for excess of chloroform favors uterine inertia and, therefore, retention of the secundines and hemorrhage.

For *forceps deliveries* chloroform should be used, as a rule, when the blades are inserted, and continued or not according as the operator desires to deliver without or with the aid of maternal effort.

For *versions* and other *intra-uterine manipulations* moderate narcosis should be induced. For *breech extractions* the chloroform is needed when the hand is introduced to seize a foot, but unless the delivery is to be hastened, the anesthetist should thereafter remove the mask, and may assist by exerting pressure upon the fundus uteri. The narcotic is resumed if the infant's hands must be brought down; and the final extraction is best accomplished under narcosis since, to avoid asphyxia, the manipulations must be rapid.

CHAPTER VII.

THE PREPARATION AND PRESERVATION OF SURGICAL INSTRUMENTS AND ACCESSORIES.

STERILIZATION.

Most surgical instruments are to be sterilized by "boiling" for ten minutes in water, to which has been added sodium carbonate (washing soda) to prevent rusting. A one per cent. solution is sufficiently strong for the purpose, but it is a convenient practice to drop about a handful of the salt into the water. Delicate instruments should be laid on top of the others in the sterilizer. After boiling, the instruments should be rinsed free of soda crystals in sterile water or in a weak carbolic acid solution. Excess of either of these fluids should be allowed to drain from the instruments, if they are to be spread out on towels, although carbolic acid solution is not apt to rust the metal during the course of an operation.

For hasty preparation in minor work, instruments may be sterilized by passing them rapidly through an alcohol or a Bunsen flame—a procedure that is not to be recommended for finely tempered tools.

Aluminum instruments are ruined by boiling in soda solution. They should be sterilized by boiling in plain water, or by passage through a flame.

Scalpels, amputating knives, urethral blades and delicate scissors should not be submitted to prolonged boiling. They may be sterilized by washing with soap and water, rinsing in alcohol and prolonged immersion in carbolic acid solution, 5 per cent., or in pure lysol. Boiling for half a minute may be substituted for the carbolic immersion, without much injury to the cutting edges.

Needles may be boiled with the coarse instruments, being

laid in the sterilizer in a small dish or fastened on a strip of bandage. Immersion in pure lysol may be substituted for the boiling. Needles are apt to be ruined by sterilization in a flame, but they may be disinfected hastily by dipping in carbolic acid. Another hasty method, not altogether to be commended, consists in igniting a thin layer of alcohol poured over the needles spread out in a dish.

Ophthalmic instruments, after boiling and rinsing, should be carefully *dried* with squares of soft, sterilized linen. Cataract knives and iridectomes may be disinfected like scalpels or by immersions in benzin, three per cent. formaldhyd solution and alcohol successively.

Male cystoscopes, laryngeal mirrors, etc., cannot be submitted to boiling, at least not in their entirety. The non-metallic parts should be disinfected by thoroughly cleansing in soap and water, and bathing in 5 per cent. carbolic acid or 3 per cent. formaldehyd solution; or washed in soapsuds, dried and exposed to formalin vapor, produced by gently heating formalin powder or tablets in a closed chamber.

Wooden handles split and become swollen by repeated boiling; but since they are, for the most part, cheaply replaced, this is not a serious matter. Rawhide mallets cannot be boiled without serious injury. They are, therefore, undesirable. If used at all, they are to be disinfected in formalin gas.

Aspirating syringes, entirely of metal or glass, or with asbestos or rubber packings, should be boiled. Those with leather packings are to be sterilized as follows: Draw up boiling soda solution into the barrel; dip the entire instrument into the sterilizer for a few seconds; eject the fluid; wash out several times with carbolic acid solution.

Injection Syringes are sterilized in the same manner, greater care being necessary, however, to secure asepsis of the barrel and the packing. With those that cannot be boiled, therefore, the washing out with carbolic acid should be done repeatedly and followed by washing with sterile water.

Syringe needles are to be boiled with the wires in place,

and these should not be removed until the instrument is needed.

Rubber materials. Instruments with well made vulcanized rubber handles may be boiled freely, although it occasionally happens that rubber scalpel handles are warped and decolorized somewhat by the heat. Razor handles are quickly warped, if boiled. Hard rubber pessaries, tongue depressors, etc., also lose their proper form in boiling water, and should, therefore, be sterilized in carbolic acid or other antiseptic solution. Hard rubber hand syringes are to be similarly disinfected, after cleansing the individual parts if necessary. "Fountain" and Davidson syringes may be boiled, as may also tubing, inhalers, dam and bandages of rubber. It is well not to boil any of these articles (unless they be of red rubber) with the metal instruments, for the latter are sometimes discolored thereby. Rubber gloves and finger cots of good quality may be boiled freely. They should be sterilized separately or floated above the instruments in the sterilizer, to avoid tearing by contact with sharp metal. Rubber *catheters and bougies* (appendix, figures 79-85, 90) may be boiled, but after being thus treated several times they become very soft and must be discarded. Catheters and bougies with shellac surfaces should not be submitted to hot water, even for a moment. They may be disinfected by thorough cleansing in soap tincture, or antiseptic soap, and immersion in carbolic acid solution. After this they may be dropped into a tube of formaldehyd-glycerin (three per cent.) in which, indeed, they may be kept between operations. Exposure of catheters, dry, in a cabinet, to formalin vaporized in a generator can be relied upon as an efficient means of disinfection.

Krotoszyner and Willard* recommend the following methods of sterilization as proven by them to be safe as well a simple:

"Soft-rubber catheters are rendered sterile by being boiled five minutes, preferably in sodium chlorid solution, care being taken that the solution fills the lumen of the

* New York Medical News, August 27, 1904.

catheter. As a matter of precaution the catheter should be washed with soap-spirits and running water after use.

"Hard-rubber and silk- and cotton-woven catheters should be boiled five minutes in a saturated solution of sulphate of ammonia. Each instrument should be wrapped separately in gauze or a towel, or if several catheters are to be sterilized, in such a manner that their surface shall not come in contact with the sides of the vessel or other catheters.

"Urether-catheters can be folded and wrapped in a towel so that their surfaces are kept apart, and boiled for five minutes in a saturated solution of ammonium sulphate."

"Instruments can be kept aseptic if they are snugly wrapped in a piece of gauze or towel wet with soap-spirits." They "lay stress on the fact that soap-spirits, after the formula of the German pharmacopœia, is to be used for soaking the gauze or towel, as soap-spirits prepared in other ways do not form the essential impermeable covering."

Esophageal probangs should be cleaned with soap and water. The sterilization of gutta-percha tissue has been described before,—wash in cold soapsuds; rinse in alcohol; immerse in cold sublimate solution until needed.

Suture Materials. Catgut and kangaroo tendon must of necessity be brought to the operation ready for use (see appendix 1). Silk, silkworm-gut, horsehair and silver wire may be sterilized, if necessary, at the time of the operation. Silk and silver wire may be boiled with the instruments. Horsehair, silk and silkworm-gut are to be boiled for thirty minutes in plain water, or in 5 per cent. carbolic acid solution. Boiling in soda solution renders silkworm-gut soft and friable. In emergency, household spool linen thread, cotton and silk may be boiled for surgical use; they make acceptable sutures.

Dressing gauze and absorbent cotton are likewise usually employed commercially prepared, or sterilized in the surgeon's laboratory. However, they may be sterilized in the patient's home by boiling or by steaming in a large kettle, and drying in an oven. If surgical gauze is not accessible, dressing materials may be secured in an emergency, by boiling

strips of muslin or linen, which can be quickly dried by pressing with a hot *clean* laundry iron.

Gauze sponges are also sterilized in live steam. *Sea-sponges* are prepared for surgical use by a lengthy process, described in appendix I.

Wax, for plugging bleeding bone surfaces, should be boiled and then poured into a sterile, shallow dish in which it is to be kept (covered) until needed (see appendix I).

Splints. As a refinement of asepsis, splints to be incorporated in a sterile dressing may be boiled, if of metal, or soaked in sublimate solution, if of wood.

Hypodermatic injection solutions should be sterilized by boiling if they undergo no chemical deterioration in the process. Nirvanin and beta-eucain may be thus boiled, but cocain solutions should not be. (These should be made with sterile water, and kept in well stoppered bottles that have also been sterilized. A few crystals of boracic, or salicylic acid, added to cocain solutions preserve them for a considerable time.) Before filling a syringe with a solution for hypodermatic use, it is well to rinse it out with a little sterile water or with some of the solution itself. Cocain solutions, notably, become turbid in a syringe that contains even a small quantity of soda solution; the syringe needle itself should be washed free of this fluid before the injection is made.

The following procedure insures against "hypo" infections, if the skin is clean: The needle (with the wire in situ) is boiled in water in a tablespoon and then thrown out on a clean towel. The spoon is again half filled with water, which is boiled and sucked up into the syringe three or four times to disinfect the barrel. A few minims more of water than it is intended to inject are then returned from the syringe to the spoon (the rest of the water being thrown away) and again brought to a boil. Then the hypodermatic tablet is dropped into the spoon and allowed to dissolve without further boiling. The solution is drawn into the syringe; the needle, handled only by its butt, is freed from the wire and screwed on; and all air is then expelled from the syringe,

held point upwards, by gentle pressure on the piston. A solid metal piston, unless it fits the syringe very exactly, has a tendency to slide by its own weight. An instrument with such a piston must therefore be held horizontally until the injection is introduced.

CLEANSING AND PRESERVATION.

Promptly at the conclusion of an operation, jars containing sterile materials should be re-covered, and as soon thereafter as is expedient, the instruments should be cleaned and dried. If they have been in contact with infected tissues it is desirable to re-sterilize them also.

The scalpels should receive attention first. They are to be washed off in cold or tepid water (hot water would coagulate any blood or other secretion that may be upon them), and carefully dried. The blades should then be wrapped in absorbent cotton. A hand-brush should not be used on knife-blades. Scalpels may be honed and stropped in the same



FIG. 26. Testing iridectome on "drum."

manner as razors and, as with the latter, the evenness and the sharpness of the edge can be tested by gently drawing it across the end of the thumb-nail and of the thumb, respectively. Cataract and Von Graefe knives may be tested on a piece of thin, soft kid (from a lady's glove) or of goldbeater's skin, stretched over a napkin ring. If the point does not enter smoothly but, instead, makes a crackling sound as it pierces the membrane, it is not perfect.

The edges of the blades of scissors, if "catchy," may be smoothed to a surprising extent by pressure between the thumb and forefinger, carried several times from lock to tip. Scissors employed in the operation itself should not ordinarily be used also for cutting gauze. Each variety and size of scissors has its own capacity, and an attempt to use it for substances or thicknesses beyond that capacity is apt to result in "springing" the instrument. Thus, ophthalmic scissors must not be used in ordinary dissections, tissue scissors are not intended to cut bandages, nor bandage shears to cut plaster of Paris.

Needles should be dipped in alcohol and thoroughly dried. The drying process may be completed by shaking the needles about in lycopodium, in a box of which they may be left until needed again. Otherwise, they may be kept in a strip of gauze, through which their bodies are thrust, or laid away in a needle-box or in carbonate of soda solution.

The coarser instruments are placed gently in a basin of water. From this they are lifted, one by one, taken apart, scrubbed with a hand-brush, rinsed, dried and re-assembled. It is recommended that the assistant familiarize himself with the names and mechanisms of the various surgical tools. Although many manufacturers stamp the corresponding blades of clamps and artery forceps with a certain number, it is best to clean these instruments one by one, to facilitate their proper re-adjustment. Locks and screws should be cleaned and dried with especial care. Holes and depressions are dried out with wisps of absorbent cotton. The drying of instruments that have inseparable joints may be made more thorough by dipping them in alcohol or, better, by warming them in an oven or *over* a flame. The lumina of cystoscopes and other hollow instruments are washed out with soapsuds, then with plain water, and dried by means of absorbent cotton wound on a probe or an applicator. Ether may be used, if necessary, to remove dried blood. A brush such as is used for tobacco pipes is useful for cleaning the channel for ureter catheters. The lumina of infusion canulæ, especially, must be made absolutely clean and dry. Steel

sounds must be scrupulously dried and polished. They are to be handled with some care to prevent denting or roughening by striking other instruments or by falling upon a hard surface. Probes are easily straightened by rolling them under the foot. Wire and chain saws, and the teeth of flat saws, are washed in soapsuds, *patted* dry, wet in alcohol and again dried. Moisture still adhering in the chain links or between the teeth may be driven off by passing the saw *over* an alcohol flame. Rouge or crocus powder used occasionally on instruments as a polish helps to remove and to prevent rust accumulations. Oxidation of the surface of silver instruments is easily treated by an application of putz-pomade, which is also useful for rust and similar stains. Fine emery is often needed for old rust spots, but it must be used very cautiously on nickel-plated instruments, as, indeed, must all the coarse household polishing powders. Finger marks and grease are removed by polishing or by the application of benzin or ether. Iodin, nitrate of silver, or mercurial solutions dropping on an instrument should be wiped away at once.* Instruments should not be laid away in contact with soft rubber, or with bottles containing any corroding substance. Saws, especially wire- and chain-saws, should be anointed with vaselin or "anti-rust" before they are returned to the instrument cabinet, which latter should be dry and reasonably dust-proof.

The efficiency of a hand syringe ought to be tested after, as well as before, an operation: The finger is pressed firmly against the point of the syringe, and the piston rod is drawn out and held for a moment to allow the entrance of air through possible leaks. On releasing it the piston should return to the bottom of the instrument. (The pistons of syringes made entirely of glass should not be released suddenly, lest their impact fracture the bottom of the barrel.) Then air is drawn into the syringe, the tip is again closed

* Stains of silver nitrate may be removed from the hands with a strong solution of potassium iodid; stains of iodin, with ammonia water; and stains of methylene blue or other anilin dyes, with strong hydrochloric acid.

with a finger, and pressure is made on the piston rod. If it yields, the syringe is defective. The tests may be repeated, using water instead of air. If on attempting to empty the syringe against the compressing finger, water escapes at the bottom, the parts of the frame should be screwed more tightly together. If this fails to prevent the leakage, the inside washer is defective or out of position, and should be replaced or re-arranged. If the fluid in a syringe escapes above the piston, when pressure is exerted against the occluding finger, the piston is too small.

A syringe that cannot be boiled, once used in aspirating infected tissues, should not be employed for injections—at



FIG. 27. Repairing aspirating syringe with leather packing.

least not until all its parts have been *thoroughly* disinfected. Syringes but little used can be kept in good order by occasionally moistening the washers and packings to prevent

shrinkage. To cleanse or repair a glass and metal syringe with leather or rubber packings, the top should be unscrewed and the piston removed. The framework and barrel are cleaned with soap and water or with benzin and then boiled, after taking out the washers. In most syringes, the piston packing can be regulated in size by means of the nut attached to it. If it be of leather and is much shrunken it should be soaked in water, but only long enough to restore it to the proper size. It may be sterilized by immersion in 2 per cent. formaldehyd solution. The piston should be re-introduced sidewise at first, and with a rotary motion. Rubber packings require lubrication with water or, if this is insufficient, with a little tincture of green soap or lysol. If the piston is of leather a little olive oil should be dropped in the cell between the two packings usually present, just as the second packing is about to be pushed into the barrel. If the small (outside) washer at the needle end of a syringe is lost or injured during an operation a substitute can be extemporized by winding about the screw-thread a little absorbent cotton.

The moisture in syringe needles after use should be blown out. This procedure may be supplemented by warming the needle several inches above a flame. The wire should then be dried and passed through the needle. If the lumen of the needle is found occluded by a plug that cannot be displaced with the wire or by the pressure of fluid from the syringe, the following device may be employed: Attached to a syringe filled with water, the needle is held in an alcohol flame, while pressure is exerted on the piston. When the needle becomes very hot, steam and water will suddenly escape through it. This procedure should be used as a last resort, however, for it injures the needle.

Fountain syringes are to be washed out and suspended, bottom up, until dry, after which their mouths may be plugged with absorbent cotton to exclude dust. Potassium permanganate adhering to glass or rubber irrigating reservoirs is easily decolorized by oxalic acid solution.

Catheters and bougies should be cleaned as described

on page 104. They are then sealed in a tube of formalin-glycerin, or are dried and either dusted with talcum powder and placed in a box, or hung in a catheter jar containing a formalin pastil. This last method probably does not in itself reliably asepticize catheters, and when employed for long periods it allows woven instruments to deteriorate.

Rubber bandages (Martin's) should be dusted with talcum and rolled up, the tape end innermost. They should be wrapped in paper or gutta-percha, and enclosed in a tin box made air-tight by means of a strip of adhesive plaster, in the same way that a plaster of Paris bandage is preserved. Constrictors are to be similarly treated. These precautions save the rubber from drying and cracking.

Rubber gloves are dried with a towel and dusted with talcum or corn-starch, then turned inside out and dried on the other surface. The glove fingers may be easily reversed by closing the opening of the glove at the wrist with a few turns of the rubber and by pressing the air thus sealed in the body of the glove toward the fingers. Punctures and small tears are patched (all on the same side) with pieces from an old glove, by means of india-rubber cement thinned out, if necessary, with a little benzin. Larger rents in the fingers may be covered with a finger cot when the glove is worn. Rubber gloves, like rubber bandages, should be kept well protected from the air.

Bandage knives cut best when they have a "saw edge." This is secured by sharpening them on a rough stone, such as a window sill.

The mechanisms of electric appliances ought to be studied and tested in advance of an operation. The poles of a galvanic battery should be lifted from the cells while the battery is out of use. It need hardly be emphasized that care must be exercised not to spill the fluid. With dry cell batteries the only caution necessary is to see that the circuit is open before the box is put away. Wet electrodes should be wrapped in rubber tissue if left in the box. Paquelin- and galvano-cauteries should also be tested before an operation is

begun. The tip of a Paquelin instrument (appendix, figure 6) should be removed while it is still hot, and before the current of benzin vapor has been turned off, for incomplete combustion of the vapor appears to favor clogging of the sponge platinum.

CHAPTER VIII.

HANDING INSTRUMENTS.

No duty that an assistant can assume is as apt to tax his forethought, skill and patience as that of "handing instruments." He must, at the same time, deliver what is needed at the moment, cleanse and replace appliances that have been used, and be ready with what may be required next. If he is not to help at the wound, in addition, he should stand as near to it as possible, that he may watch every step in the operation. He must observe closely and act promptly. *If the surgeon works rapidly the instrument hander must think more rapidly.* His duty is to *anticipate* the operator's needs and to adapt his armamentarium to conditions as they are developed. That assistant is useful who can, at each step, place the appropriate appliance in the hands of the operator, just one instant before the latter realizes that he needs it. Often deeply engrossed in the study of the condition present, the surgeon will be grateful for the suggestion, when there is handed to him at the right moment the right thing with which to meet that condition.

The instrument hander should therefore think out in advance the various steps of the operation and the complications that may arise at each, and he should prepare his materials accordingly. They ought to be arranged conveniently and systematically on his table.

Powder sifters (appendix, fig. 7), cautery handles, and other unsterilized articles should be wrapped in pieces of gauze (which may be held in place with a bit of catgut or a safety-pin), or handled with towels, and jars and basins that are placed near the instruments should be surrounded with towels to prevent infection of tools or fingers by accidental

contact. The instruments themselves should be laid out, as nearly as possible, in the order in which they will be needed, *e. g.*, for a laparotomy,—scalpels, hemostatic forceps, mouse-tooth forceps, scissors (straight and curved), retractors (sharp and blunt), etc.; for an osteotomy,—scalpels, hemostats (if no tourniquet is used), retractors, periosteal elevators, raspatories, chisels and mallet, sharp spoons, etc.; for a curettage of the uterus,—speculum, volsellum, uterine sound, dilators, curettes, intra-uterine irrigating tip, dress-

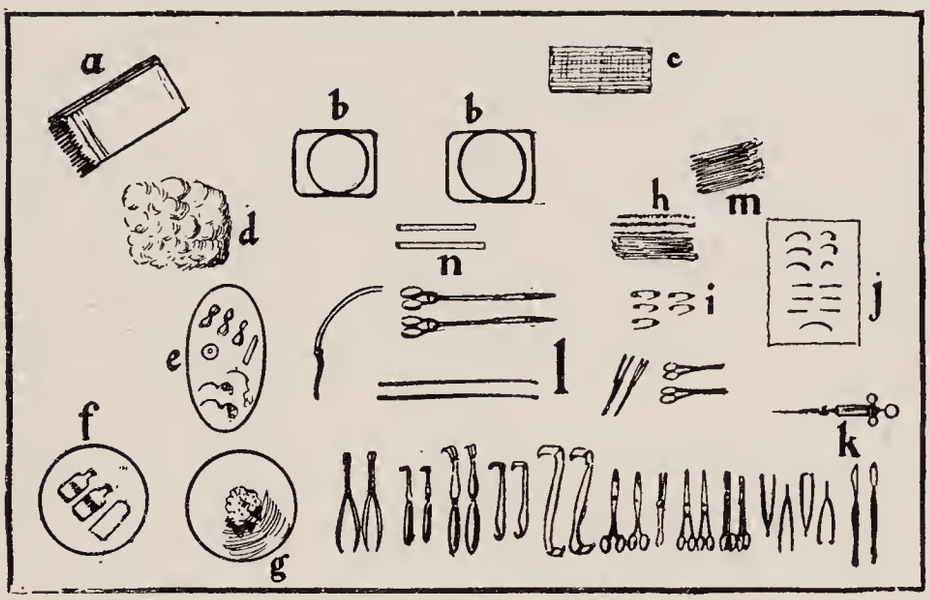


FIG. 17. Instrument table. *a*, sterilized towels; *b*, *b*, gauze jars; *c*, sterile adhesive strips; *d*, sterile absorbent cotton; *e*, dish of alcohol for prepared sutures and ligatures; *f*, dish of sublimate solution, one-fifth per cent., for ligatures in bottles and gutta-percha; *g*, basin with sponge for cleansing instruments; *h*, packings; *i*, sterilized safety-pins; *j*, needles; *k*, aspirating syringe; *l*, the other instruments arranged in the order in which they will be needed; *m*, pads; *n*, drainage tubes.

ing forceps. It will be convenient for the instrument hander to lay aside for his own use in preparing sutures, packings and the like, a pair of straight scissors, a pair of curved scissors, a pair of thumb forceps and, if the sterilizer is kept at hand, a pair of dressing forceps to lift instruments out of it. Syringes are to be tested, as previously described, and the adjustment of complicated implements carefully inspected.

The needles are spread out (dry, or in a dish of alcohol),

according to their shapes and sizes, so that at any moment an appropriate needle may be quickly selected. Operators have individual fancies in the use of needles but, in a general way, it may be stated that the ordinary curved surgical needle is most generally useful, that needles curved in a half circle are well adapted for deep suturing in narrow spaces and for passing a mass ligature, and that small straight needles are of great service in intestinal work. The Hagedorn needle, which is flat and sharp (fashioned at the point somewhat like a half-spear-head) and has a large eye, is given the preference by many surgeons. It is used with a Hagedorn needle-holder, or passed with the fingers alone. The instrument hander should select a needle strong enough for the tissues which it is to traverse, but otherwise no larger than is necessary to carry the suture. See appendix, figure 27.

If suture materials are brought to the operation in bottles or sealed tubes, these may be sterilized in sublimate solution, or opened in a towel (the tubes are to be broken) and the contents dropped into a dish of alcohol. Spools that are mounted in wide-mouthed jars are, of course, not to be removed. With these the free end of the silk or gut should be drawn up with forceps, and as much as is needed for a suture or a ligature cut off about an inch from the reel, care being taken to keep the material, the instruments and the fingers from contact with the edge of the jar. A supply of *ligatures* eight to nine inches in length should be prepared in advance. They are coiled up, ring-like, by wrapping them about two fingers of the left hand (*not* about the nails), and then laid back in the alcohol. If the free end of the ligature thus coiled is twisted once around a segment of the ring, it will prevent the ligature from straightening out again in the dish. Catgut of the size numbered 2 in figure 28* is most generally useful for ligatures, but number 1 may be used in delicate plastic work, as on the face, while heavier material (number 4 to

* The scales of numbers employed by different manufacturers are not identical. The ligature numbers referred to through the text are intended to indicate sizes that correspond to those numbers in figure 28.

number 6) is needed for large pedicles (as of the renal vessels) and similar "mass ligatures."

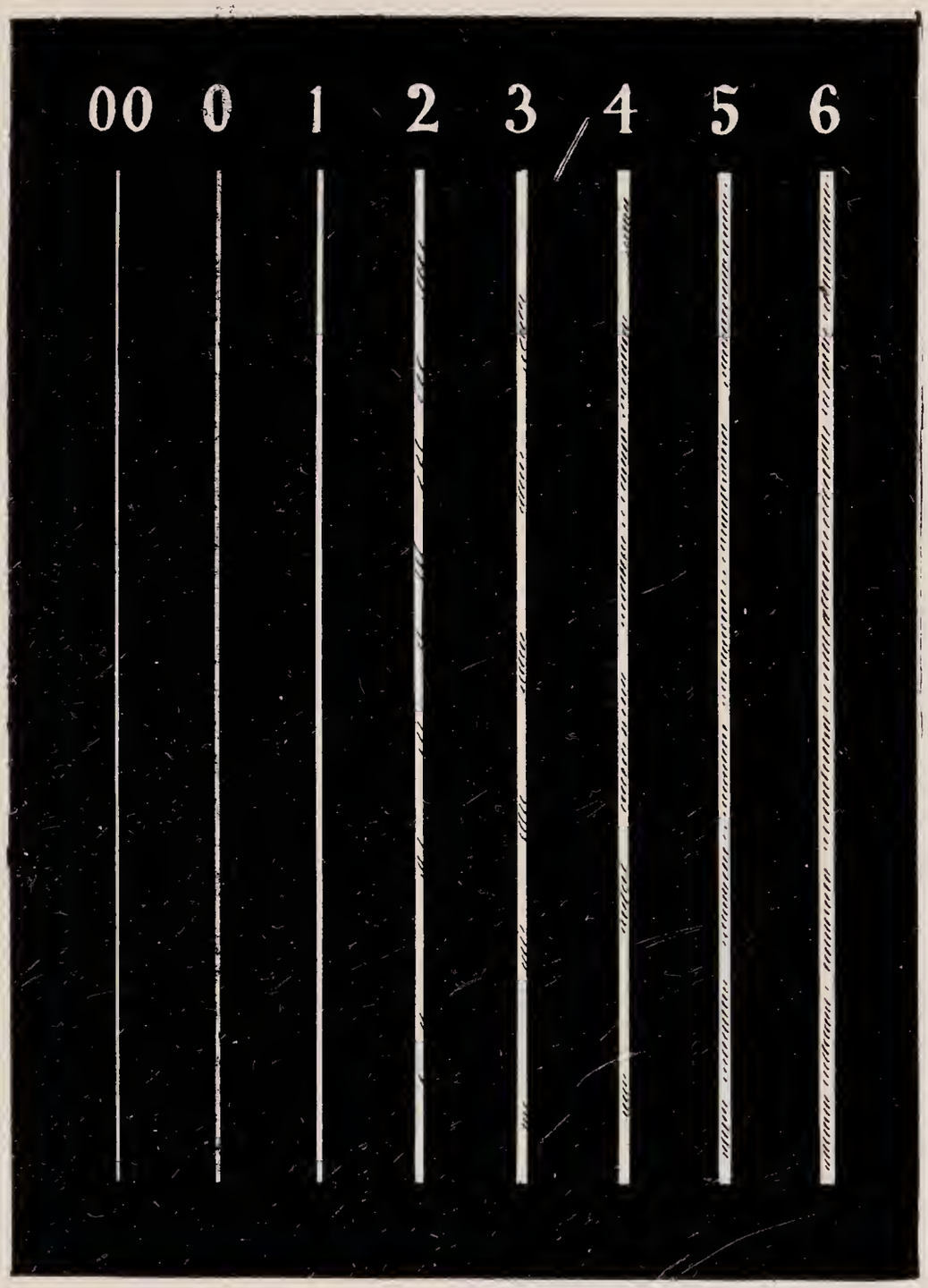


FIG. 28. Surgical catgut—scale of sizes.

Two, at least, of each kind of *suture* that will be needed should be threaded in advance, rolled up with the needle, and placed in the ligature dish. Sutures of the size correspond-

ing to number 1 in the scale here given will be most often needed. For ophthalmic operations and other delicate work, sutures numbered 0 and 00 will be useful, while the indications for heavier material are obvious. Twisted silk is most convenient in the smaller sizes, braided silk in the larger ones. In general, sutures should be about twelve inches long, depending upon the length of the wound to be united and the manner in which the stitches are to be placed. It is a less serious fault to cut a suture rather too short than to hand one too long, for long threads are apt to drag over the skin, and are awkward to manipulate.

In threading, the suture should be held close to its end between the right thumb and forefinger, the needle, correspondingly held in the left hand, being passed over it. If the

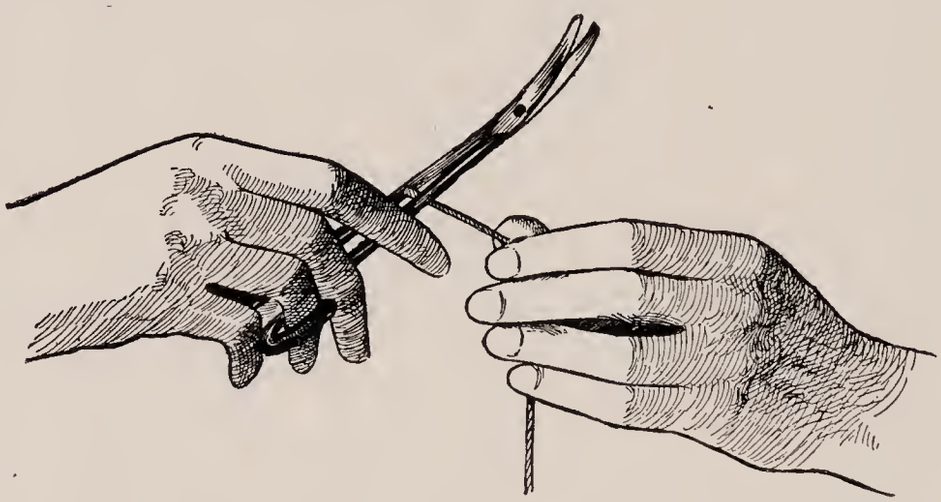


FIG. 29. Squeezing end of catgut for insertion in eye of needle.

needle-eye rebels against the passage through it of a piece of catgut or kangaroo tendon, the difficulty can usually be overcome by cutting the end of the suture obliquely and flattening it by pressure between the handles of the scissors. Silk, however, should be cut squarely across, lest its strands unravel on attempting to pass it through the eye. Small sutures are apt to slip out of the needle unless fastened to it with a single knot. Silkworm-gut is secured by twisting it several times, or more correctly, by twisting the needle on its long axis while holding the loop of silkworm-gut steady. Silver wire is prevented from slipping out of the

needle by flattening the short and long end together and, if necessary, by twisting them slightly on each other.

"*Button sutures,*" used after breast amputations or laparotomies, when there is great tension to be overcome, are to be prepared by mounting on stout silk, or on one or two strands of silkworm-gut, a piece of block tin about a half inch square, and a large lead shot, both perforated. The corners of the tin are trimmed to protect the skin, for which account the sharp edges of the button should also be turned up

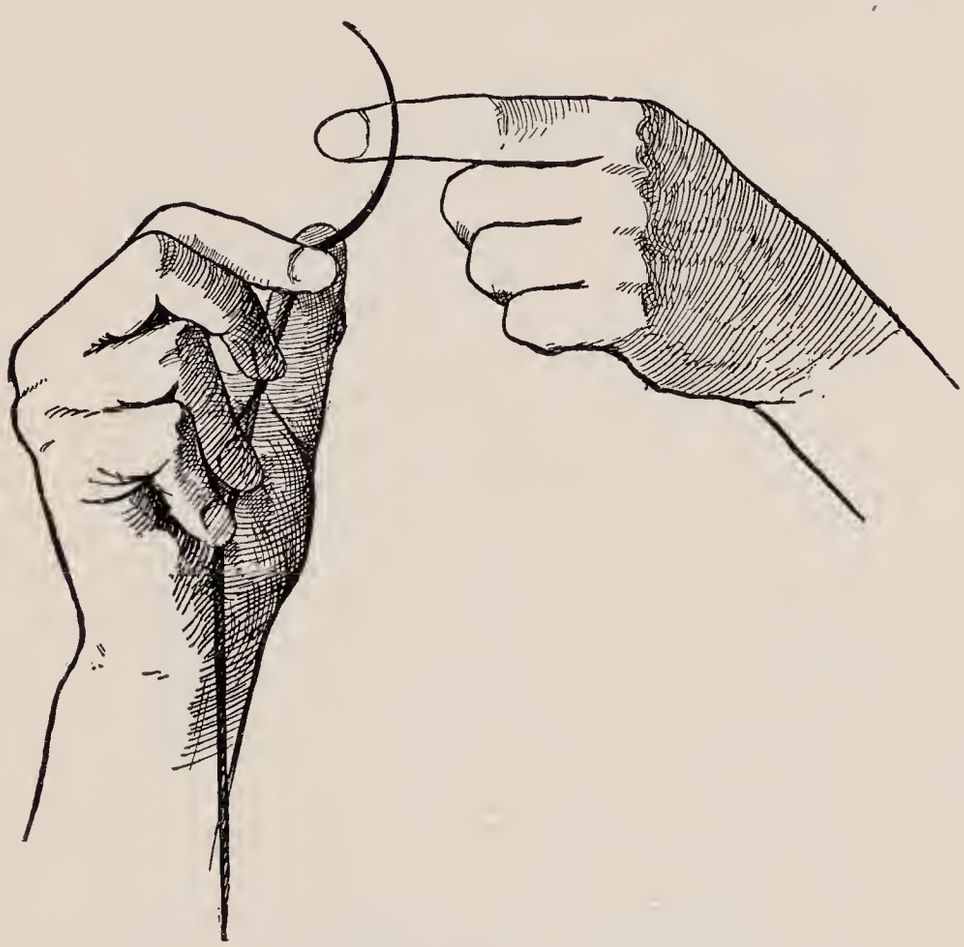


FIG. 30. Twisting silkworm-gut suture.

(towards the shot). After the button the shot is slipped on the suture, and clamped about a quarter of an inch from the end by compression with a needle-holder or other heavy instrument. Instead of the tin and shot, an ordinary bone or china button may be used, two strands of silk or silkworm-gut being passed through its holes and tied together on its concave surface. Buttons of all kinds are apt to cause pressure

necrosis of the skin; for them may be substituted small rolls of gauze or pieces of rubber tubing, over which the suture ends are tied (*quilled sutures*).

When handing a suture to the operator the needle should be grasped near its eye in the holder, the point of the needle should be to the operator's left and its concavity towards him. When a reversed suture is to be passed the position of the needle in the holder is to be reversed, as it is to be, also, for



FIG. 31. "Button suture."

left-handed operators. If the needle-holder has a tapering end, only flat needles should be grasped near its extremity, for curved ones are apt to be broken by the narrow tip. With the suture should be handed a mouse-tooth forceps, and a pair of curved scissors. With "button sutures" should also be handed a hemostat, to secure the free end of the suture after it has passed through the tissues, until the operator is

ready to fix it permanently with a second button and shot. These the assistant should hold to him in the palm of his hand, and should pass after them an instrument for compressing the shot. Especial care should be exercised that suture ends touch nothing but the assistant's hand in transit from instrument table to operator.

Some at least of the gauze drains and packings that will be needed should be prepared in advance. It is well, too, to prepare the dressing and lay it aside, covered with a towel. For mastoid operations slender strips of gauze will sometimes be



Fig. 32. Handing gauze packing.

more useful than sponges for cleaning narrow recesses. For laparotomies, several packings of various widths and appropriate thicknesses should be cut and kept in readiness on the instrument table. If the intestines are apt to be much exposed, hot towels and pads should also be at hand. These are

made ready when needed, by folding them in the center of a towel, which is to be dipped into a basin of water kept hot over a small flame. The towel is then wrung by its dry ends, and the pad is lifted out.

Laparotomy pads should be handed with that corner uppermost to which is usually sewed a strand of stout silk for the attachment of an artery clamp to be left hanging outside the belly. With pads or abdominal packings should be handed, for their introduction, a pair of blunt scissors curved on the flat, or a similarly shaped instrument. (Figure 32.)

Split compresses are made by dividing folded pieces of gauze half way through their middle. They are useful for surrounding an appendix to prevent soiling of the other tissues when it is amputated, for dressing about the projecting end of a drainage tube, etc.

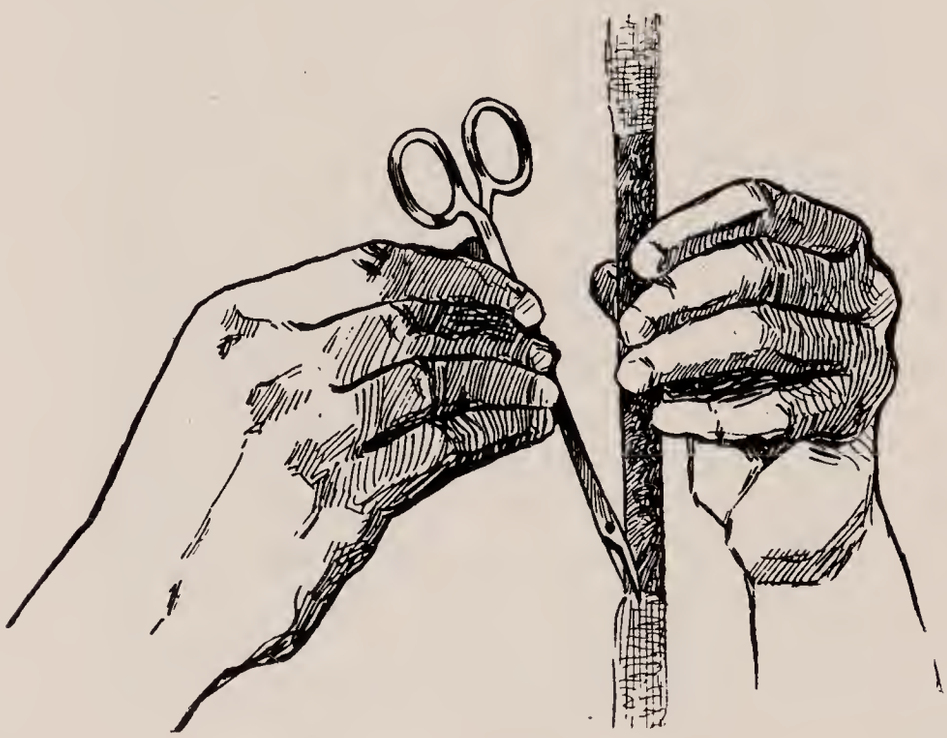


FIG. 33. Handing "cigarette" drain.

The *Mikulicz bag* consists in a few layers of gauze which are laid flat into a wound (*e. g.*, after nephrotomy) and tucked into all its recesses. The edges of the " bag " project beyond the skin. Packings are laid in the wound thus lined with gauze, and renewed at intervals, the bag itself being left

in place for several days (usually until it is loosened by wound secretions).

Gauze drains should be trimmed evenly, and freed of ravelled strands. The *cigarette (or Morris) drain* consists in a wick or roll of gauze of appropriate size, wrapped in gutta-percha tissue. The free edge of the rubber may be fastened down by *slightly moistening* it with chloroform. The gauze must project beyond the rubber at each end. This drain combines the advantages of gauze capillarity with the ease of removal of rubber tubing. It is introduced with dressing forceps or with the fingers.

Drainage tubes should be cut obliquely at the deep end, and the edge of this cut bevelled with curved scissors. Fenestræ may be cut along the tube, of size and number determined by the nature and quantity of the discharge to be drained.

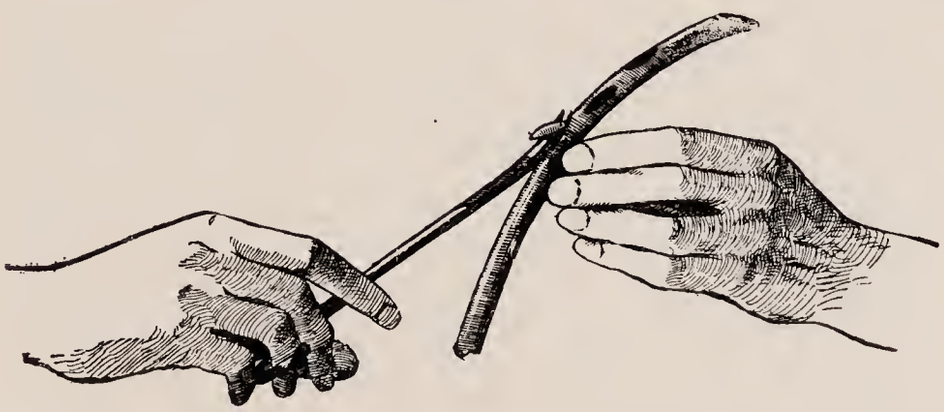


FIG. 34. Preparation of drainage tube.

Two medium-sized tubes drain better than one large one, more especially since they afford the means of recurrent irrigation. A safety-pin is usually fastened through the project-



FIG. 35. Fenestrated drainage tube.

ing end of the tube. For introduction through a narrow or an irregular tract, the tube may be stretched tightly over a large probe, the tip of which impinges against the inside of

the rubber near the end. Traction threads, for pulling tubing through a sinus, or attaching tampons, are best fastened by a *clove hitch* (the manner of making which is shown in figure 37), which is secure but easily removable.

The preparation of the *tampon canula* and of the "*canule*

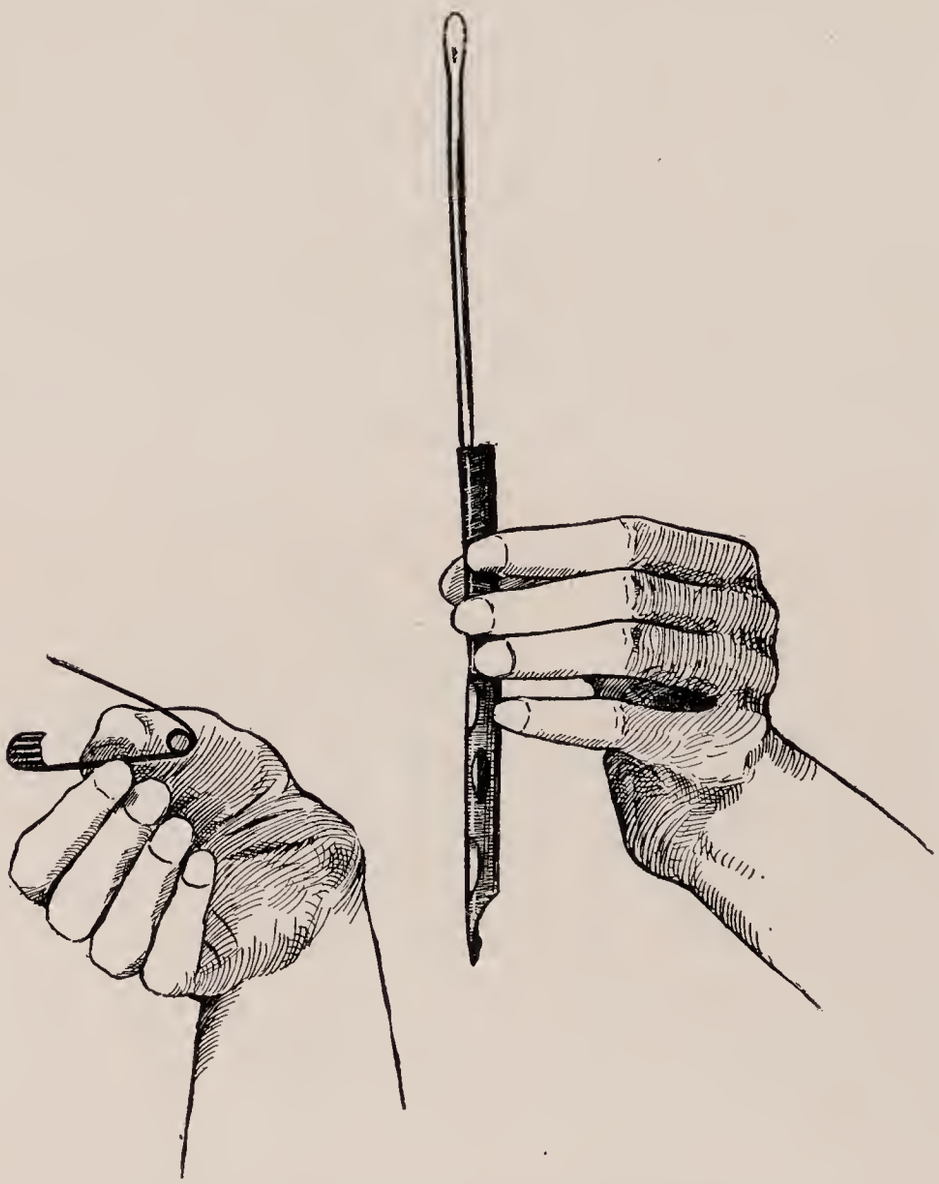


FIG. 36. Handing drainage tube on probe.

en chemise" will be more appropriately described in discussing assistance at rectal operations.

In the manner of passing an instrument, there is an art. *Every appliance or dressing should be placed in the grasp of the operator in the direction and position in which he is to apply it in the wound.* This relieves him of the necessity of

lifting his eyes from the operating field to the appliance, and of turning the latter about in his hand.



FIG. 37. The clove hitch. *a*, formation; *b*, application.

Beginning with the scalpel, the blade should point approxi-

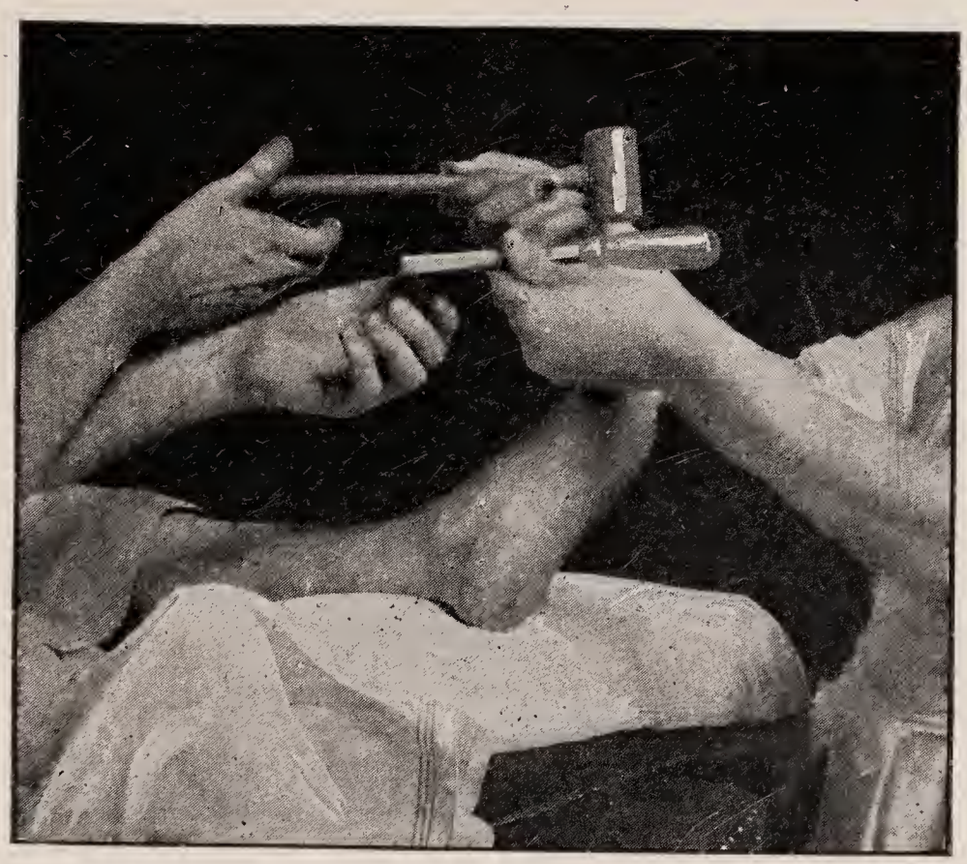


FIG. 38. Incorrect manner of handing chisel and mallet to operator.

mately in the direction of the wound to be made, when it leaves the assistant's hand. Several artery forceps should

be laid near-by while the incision is in progress, and the handles should point towards the operator—or, better, some should point towards the operator, and some towards his assistant at the wound. (If the scalpel used for the skin incision is now replaced by a second one, the chances of conveying infection into the wound from the skin are thereby diminished.) The sharp retractors that may next be needed should be held by the instrument hander by their shanks, and the handles should be pointing away from the wound and at



FIG. 39. Correct manner of handing chisel and mallet, suited to the position of the operator and the direction of the wound.

right angles to its axis. So, too, with the mouse-tooth forceps next required. One should be held within easy grasp of the operator, the other in the position in which his assistant will apply it. So, too, with sutures, the instrument passer should place the needle holder with his left hand into the right hand of the operator and the forceps with his right hand into the surgeon's left. And so, too, with all the instru-

ments and all the dressings, even down to so small an article as a safety-pin.

During the course of an operation, only those few instruments in immediate use should be left on the patient's body, or on the " invalid table " over his body, and these should be cleaned whenever blood accumulates upon them. Others that have been used should be cleansed and replaced on the instrument table or, if they have been soiled by infectious



FIG. 40. Handing suture and forceps.

material, laid apart from the instruments that are still sterile. The assistant should see to it that instruments lying on the patient's body are not brought in contact with the elbows of the operator, that the sharp points of tools are turned downwards, and that the towel on which the instruments are allowed to lie is replaced when it is blood-soaked or otherwise soiled.

The assistant who hands sponges should observe the same system. She must watch the operation closely to adapt the sizes of the sponges to the needs developed. If gauze "wipes" are used, several may be placed near the wound,—by means of a pair of forceps to avoid undue handling. If sea-sponges are being employed she ought to have a clean one always in her hand, ready when needed. This sponge she passes from her fingers to the wound-assistant's palm, taking the soiled sponge from his fingers into her palm.

The soiled sea-sponge must be passed through two basins of cleansing solution, then squeezed thoroughly. When the sponging is active it is well to have one or two sponges lying near the field of operation, for nothing is more annoying than to have to wait for a fresh sponge—except, perhaps, to be obliged to wipe a wound with a sponge already soaked with blood.

Cotton sponges, little used except in minor surgery and for ophthalmic work and wound-dressings, may be neatly made from squares of absorbent cotton. The edges of these



FIG. 41. Cotton sponges.

may be twisted together, thus making a loose ball. A better method, but one requiring a little more dexterity, is the following: The left hand is made into a loose fist, and the square of cotton is laid on the thumb and fore-finger. In the centre

of the square is placed a smaller bit of cotton to make the sponge more solid. With the index finger of the other hand, the edges of the cotton are turned in; then this finger is held in the centre of the sponge, which is rotated about it with the left hand to make the ball compact.

Sponge holders and *applicators,* like other instruments, should be passed in the proper direction. Thus, for sponging in the depth of the abdomen the sponge-holder is handed vertical, the sponge downward; for sponging in the vagina, the holder is handed horizontal, the sponge forward. It is important that sponges should be fastened compactly and firmly in their holders, and that cotton should be firm on applicators. Applicators with square ends are better than those with corrugated or spiral ones, for they hold the cotton securely yet allow of its easy deliberate removal. The winding of cotton about an applicator should begin furthest from the tip, and here the cotton, small in amount, must be pressed firmly between thumb and finger. As the tip is brought down through the fingers the pressure is lessened, making the cotton here less firm but thicker and more absorbent.

Nitrate of silver may be attached to a probe or applicator in full strength, for use in the middle ear, etc., by heating the tip of the instrument in a flame and pressing it into the solid caustic. This melts a little of the salt, which on cooling forms a bead on the probe. For use in more accessible situations the nitrate of silver cone may be conveniently mounted in a discarded thermometer case by means of a little paraffin or of a strip of adhesive plaster.

CHAPTER IX.

ASSISTANCE AT THE WOUND.

In the immediate assistance in an operation, close attention and manual gracefulness are far more to be cultivated than the display of mere brilliancy of technic. Only by strict attention can the assistant supply the needs of the moment and foresee the requirements that will next develop. He should be always ready to do his share, undirected; he should not try to do more than his share. At each step of an operation he should be close at hand, yet never in the way—"always there," but never "too much there." How many of the manipulative details he may undertake himself must depend upon his own technical experience and upon his familiarity with the surgeon's methods. An ill-considered act may spoil an hour's work; on the other hand, a quick movement—likewise unsolicited—may save a patient's life. Whatever the assistant does, he should do quietly, without disturbing the operator and, if possible, without waiting for him to give orders. If all the assistants are thus quick, and sufficiently familiar with the technics of the procedure at hand, and with those of the individual surgeon, *a long and complicated operation can be, and should be, conducted from beginning to end without a word being spoken.*

The surgical assistant must work unobtrusively, and a primary principle of his art is, that his every move must be directed by a consideration of the convenience of the surgeon. He will hardly allow himself to interfere with the operator's line of vision or to obstruct his light if he bear in mind that the dispatch with which an operation can be carried out depends much upon the manner in which the assistant disposes his body, as well as that in which he employs his hands.

Dexterity in the proper use of the hands implies also the use of the proper hand. Nothing can contribute more to

the graceful conduct of an operation and to the serenity of the operator, than careful regard to this apparently small

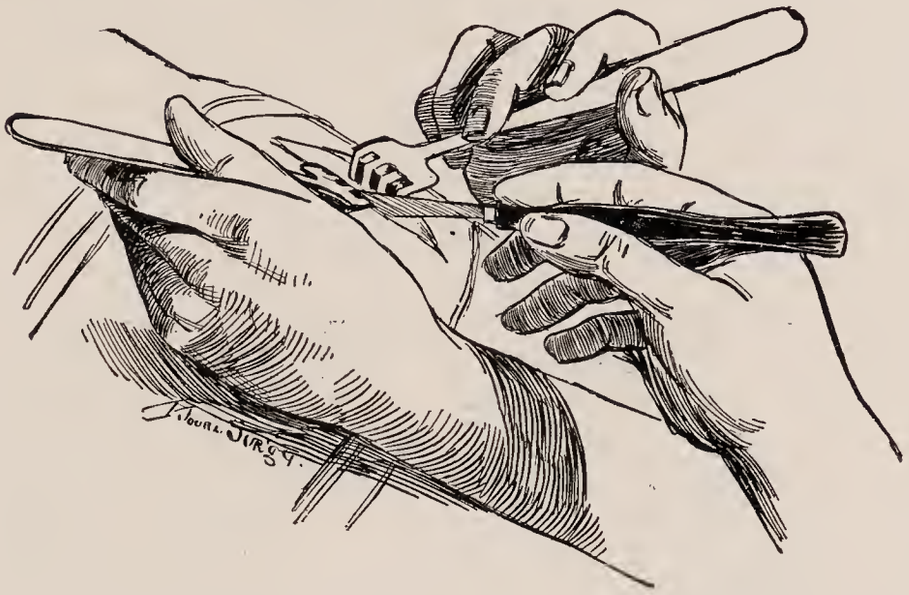


FIG. 42. Incorrect manner of holding retractors; assistant's left forearm interferes with operator's movements.

matter. In manipulations through the vagina especially, where the field is relatively small and the number of instruments in use is apt to be large, awkwardness in the position of the assistant's arm or in the assignment of his work to one or the other hand, is often the cause of annoyance and of delay.

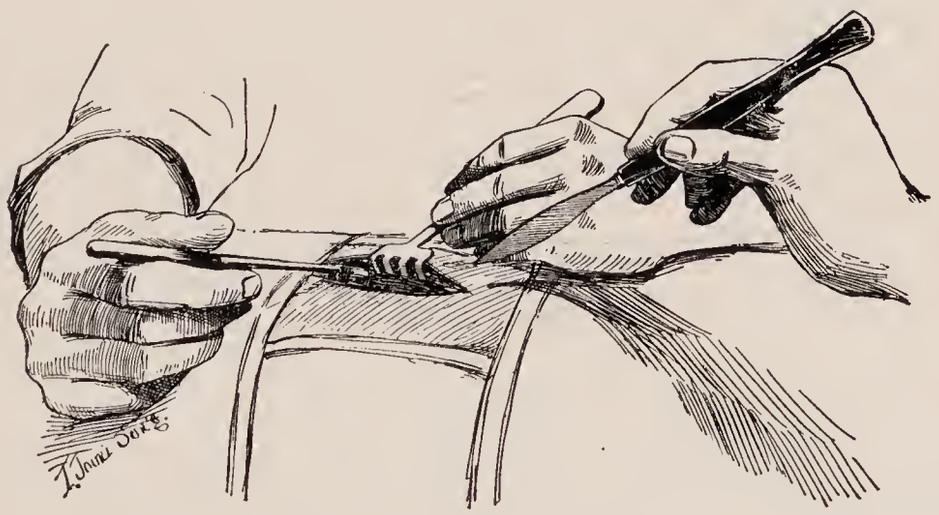


FIG. 43. Proper disposition of hands and arms in manipulating retractors.

THE INCISION may be facilitated by aiding the operator in stretching the skin. This is done with the left hands and in

a direction at right angles to the proposed line of incision, the assistant's right hand holding a sponge in readiness to dry the wound. A long incision through a loose fold of skin, as of the scrotum, may be accomplished by a short downward sweep of the knife, if the tissue is pinched up on each side with the thumb and forefinger.

SPONGING is perhaps more than any other one thing during an operation, what most requires the employment of a



FIG. 44. Stretching the skin to facilitate primary incision.

diligent assistant. The wound must be kept dry at all times. To accomplish the best result with the least interference to the operator the sponge should be used *frequently,* in the short intervals between the operator's manipulations, with a *quick, wiping* movement, and quickly withdrawn from the line of vision. To remove fluids from the abdominal or other cavity, a rotary motion should be imparted to the sponge—

especially useful if the fluid is thick and viscid. To prevent soiling of the abdominal contents with pus or feces escaping from a small opening, bits of sea-sponge should be used, either prepared on artery forceps or lifted from a dish, one by one, with thumb forceps. The manner of passing and cleansing sea-sponges has been described. Sponges soaked with pus or other infectious material should be discarded at once, not cleansed. Obscuration of a wound by the oozing of blood from one angle may often be quickly obviated by pressing a sponge or a bit of gauze into that angle.

A few rules are worth remembering:

Hold the sponging hand *near* the wound; not over the wound.

Keep the wound dry; sponge *quickly* and *often.*

Use dry sponges; have fresh sponges within reach.

Wipe; don't dip.

Don't sponge against the operator's knife or needle-point.

Sponge from the wound towards the skin: never from the skin into the wound.

Never use in a clean wound a sponge that has been on the skin or in contact with infectious material; discard it at once.

RETRACTING. Next to assiduous sponging, the intelligent use of retractors is most helpful in the facilitation of an operation. Their purposes are two-fold—to expose and to protect. They should be so placed as to best display the tissues under immediate manipulation—usually in a direction at right angles to the wound, or in the angles of the wound. They should be inserted carefully and deliberately, never blindly or hastily, lest they cause laceration or mangling, or push from view structures that ought to be exposed. In retracting an abdominal wound, especially, great care should be exercised to avoid including the intestine in the grip of the instrument. Traction force should be exerted gently and steadily—enough to satisfactorily open the wound, but not enough to bruise the tissues. When using sharp retractors all the prongs should be sufficiently buried to prevent slipping and to avoid injury to the surgeon's fingers; but if the superficial tissues are being retracted, the assistant should see that

the prongs are not forced through the skin from beneath. As the dissection or other manipulation proceeds deeper and deeper or from one place to another, so the retractors should be shifted—a process that again should be conducted with due regard to the operator's fingers. Whenever expedient, it is best to insert a second retractor in the new site before removing the first retractor from the abandoned position. When a retractor is no longer serving a useful purpose it should be removed; but if the assistant is in doubt as to its continued utility he had better leave it in position until directed otherwise. In any case, a sharp instrument should not be withdrawn from beneath the operator's hand or forearm.

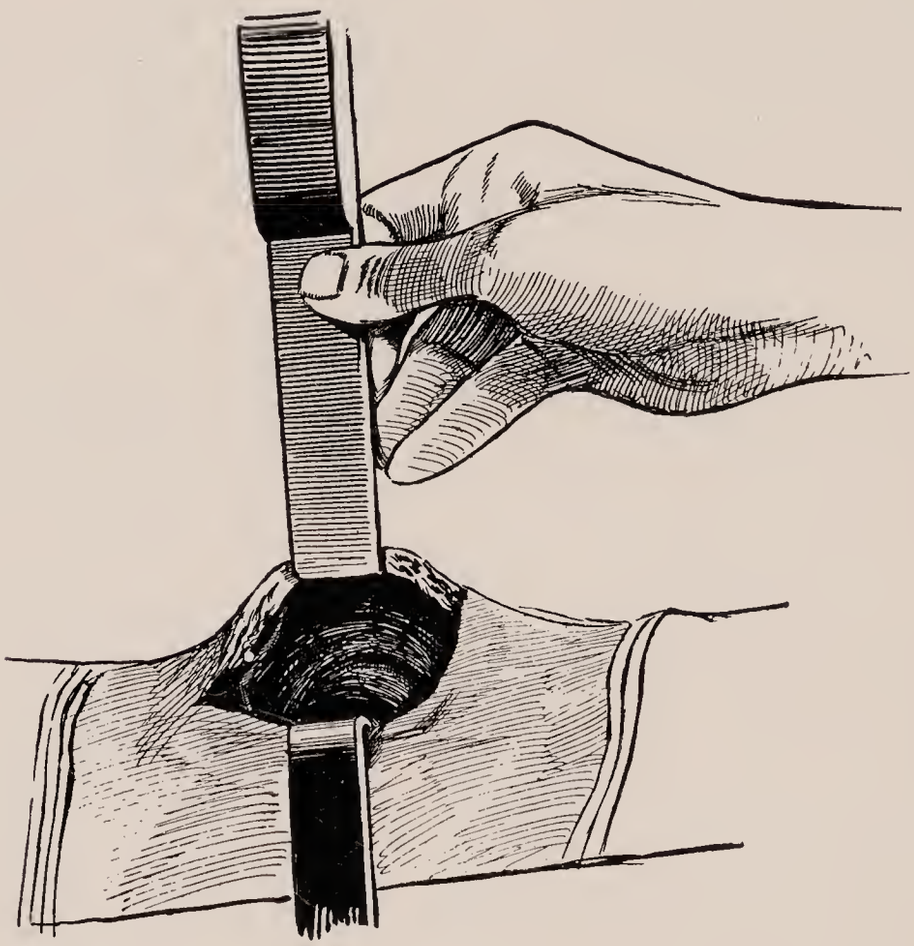


FIG. 45. Use of retractors to expose to view a large visceral surface through a relatively small opening.

The assistant should early learn the value of *lifting up* with the retractors. During laparotomies, especially, this

simple procedure is of invaluable aid, in separating and displaying the various layers of the abdominal wall and their bloodvessels and nerves, in drawing the parietal peritoneum from the viscera beneath, and in exposing the abdominal contents to visual exploration through a relatively small opening. All other things being equal, blunt retractors should be given the preference for use in the neighborhood of large bloodvessels and of intestinal or other delicate structures. Well-curved blunt hooks and blunt retractors should be chosen for distracting a nerve or bloodvessel or a tense muscle (*e. g.*, the rectus abdominis). Obviously, a retractor should be selected with reference to the size and depth of the wound, for its purpose is to create space, not to obstruct it.

Blunt curved scissors are useful for temporary retraction. The assistant's fingers may be similarly called into requisition, but they should be thus employed only when no instrument at hand will equally serve the purpose.

An assistant whose sole duty may be to hold a retractor for even an hour or more, should not allow himself to become listless and to loll over the table or to bear his weight upon the instrument, for aside from the fact that this is inelegant and indecorous, prolonged pressure upon the patient's skin by the shank of a retractor is apt to cause troublesome necrosis.

DISSECTION. The character of the assistance required in this procedure is indicated by the manipulations of the operator. Dissection conducted layer by layer between two mouse-tooth forceps requires of the assistant to seize the same tissue as does the operator, near to, and directly opposite, the point where he attaches his forceps. The structure grasped is then drawn up, allowing the passage of scalpel or scissors between the two instruments. Only the tissue to be divided should be seized—obviously a very important consideration in incising the parietal peritoneum. The assistant should not, as a general rule, relinquish his grasp until the operator has removed his forceps to another position, when the assistant follows him thereto. For seizing a bloodvessel, to dissect it from its bed, anatomical forceps should replace

toothed instruments. Either hand may be used for the forceps, the other one holding a retractor or a sponge.

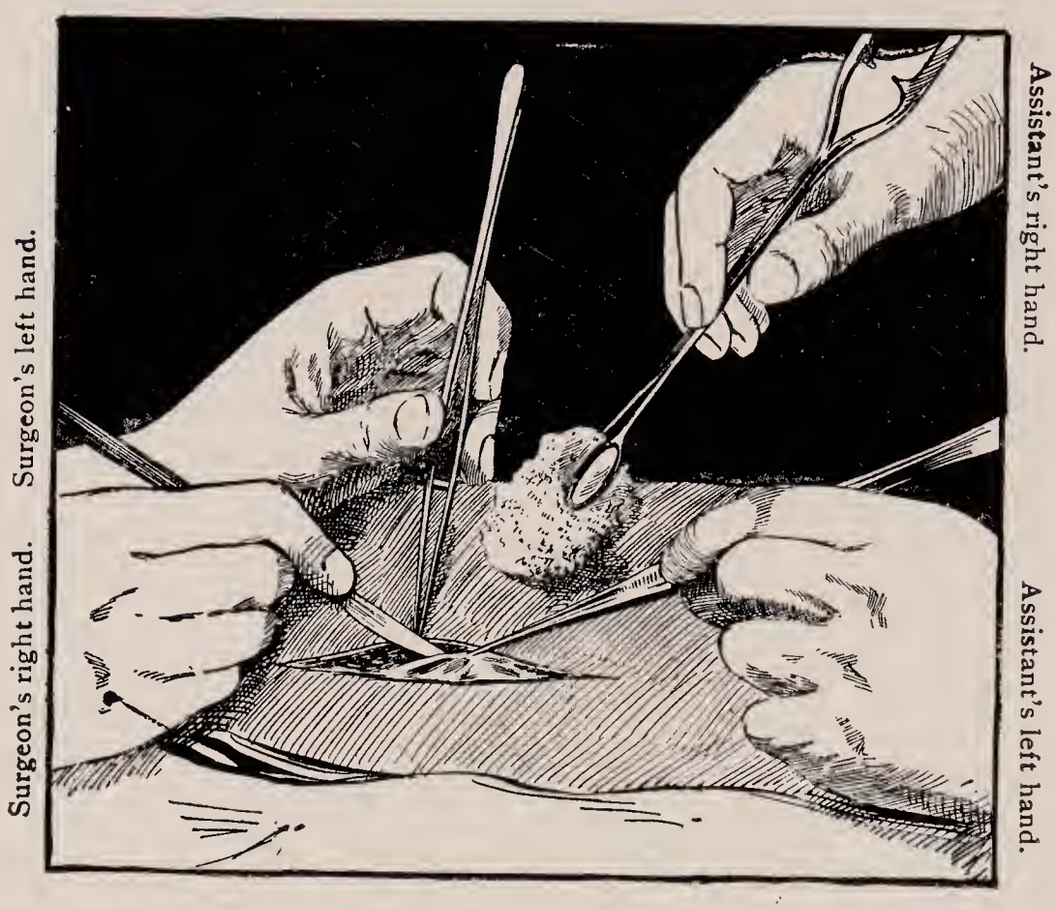


FIG. 46. Dissection between mouse-tooth forceps.

HEMOSTASIS. We have said that the most useful service an assistant at the wound can perform is assiduous and intelligent sponging. When divided vessels are to be clamped it is especially important that he sponge the bleeding surface in order that the exact location of the hemorrhage may be seen. A stream of blood from a single large vessel should be stopped at once by the assistant's finger, until the surgeon has properly exposed the vessel for clamping.

If there is simultaneous bleeding from several points, as there usually is after a long incision, the assistant may take part in the application of hemostats. This he should do deliberately, however quickly, taking care to secure in the grasp of the instrument as little as possible of the tissue surrounding the mouth of the bleeding vessel. When there has been exposed a vessel that must be "ligated in continuity," while

the surgeon clamps it at one end the assistant clamps it at the other; and here, too, he must be careful to catch in the forceps no nerve or other structure that it is desirable to preserve. When securing a vein in continuity it is well to grasp it proximally first, lest otherwise it collapse and become lost to view. An inadvertent nick in the side of a large vein is to be closed with a small "bite" of the hemostat, thus allowing the application of a "side ligature."

When the number of hemostats applied to the wound is large enough to obstruct manipulations, or when the supply of these instruments is nearly, but *not entirely* exhausted, some or all of them may be removed. Small vessels, *e. g.*, many of those in the skin, are usually definitively closed by the mere pressure of the forceps for several minutes, and slightly larger vessels may be closed by twisting the forceps a few turns before removing them; but vessels of any considerable size are to be tied before the hemostats are withdrawn. Several ligatures may be applied in a short space of time if the assistant affords intelligent aid. He should lift up each hemostat in turn in order that the ligature may be passed behind it, so holding the forceps that the tissues to which it is applied are not twisted or distorted. After the ligature is passed behind it the handle of the forceps is dropped or depressed, in order to lift up the point of the instrument beyond the ligating loop. If, however, the forceps' beak is too deeply buried in the tissues to accomplish this, the assistant should draw *gently* upward on the hemostat while a single knot is formed loosely about it. The loop of catgut can then usually be helped to slide over the beak if the hemostat is rotated slightly from side to side. Sometimes, however, the surgeon or the assistant will be obliged to push the loop down with a finger or with an instrument. If it has not been thus necessary to hold the forceps up while the first knot is tied, the assistant should seize it again immediately thereafter, in order to remove it when the knot is complete. Occasionally it is useful, when working in a small space, to remove the clamp after the first knot is secured. While the assistant's left hand is thus occupied with the manipulation

of the hemostat, his right should hold in readiness a pair of scissors to cut the ligature ends. Blunt-end scissors, curved on the flat, are best adapted to this purpose. They should be held, with the concavity of the curve uppermost, by the terminal phalanx of the thumb and the middle phalanx of the fourth (or third) finger. Downward pressure with the thumb and upward pressure with the fourth finger secure close contact of the edges when cutting, while counter-pressure of the index finger over the lock steadies the instrument.

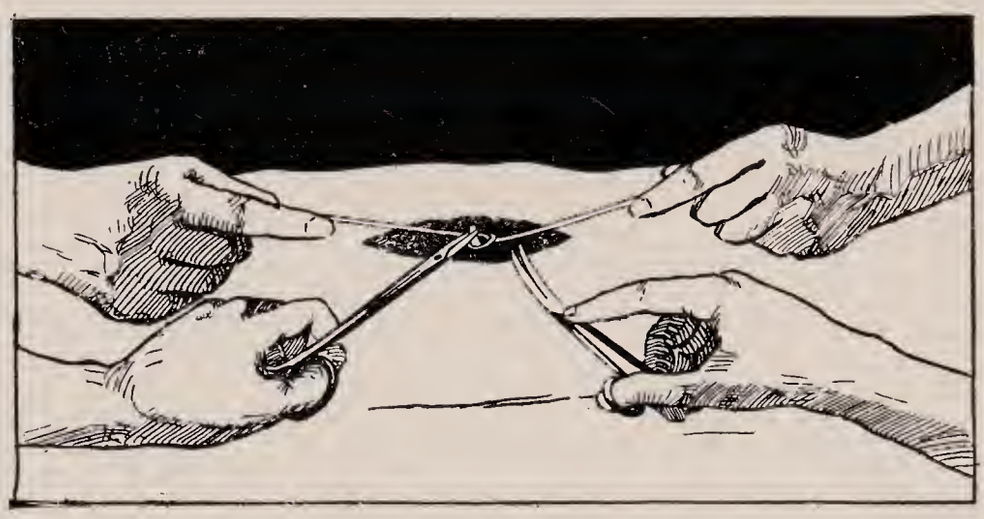


FIG. 47. Manipulation of hemostat and scissors in the application of a ligature.

The fifth finger may be rested on the patient's body to balance the hand. The scissors are held slightly open while the ligature is being tied, and when the surgeon lifts its free ends, the blades are made to surround them. With a quick movement at the wrist the blades are to be carried down along the strands and closed about a quarter of an inch from the knot. These manipulations, longer in the description than in the performance, secure speed as well as precision.

The assistant is often called upon to apply ligatures himself. The "square," "flat," or "reef" knot is formed by passing one end of the ligature, *e. g.,* that in the right hand, *in front* of and around the other end into the left hand, and tightening the first knot; then passing the *same* ligature end back from the left hand *in front* of and around the other end, as before, into the right hand, and tightening the second knot.

If the second loop is made by passing the ligature end in a manner different from that in which it was passed in the first loop *(i. e.,* behind, instead of in front, of the other strand), there is formed a "granny knot." Such a knot is

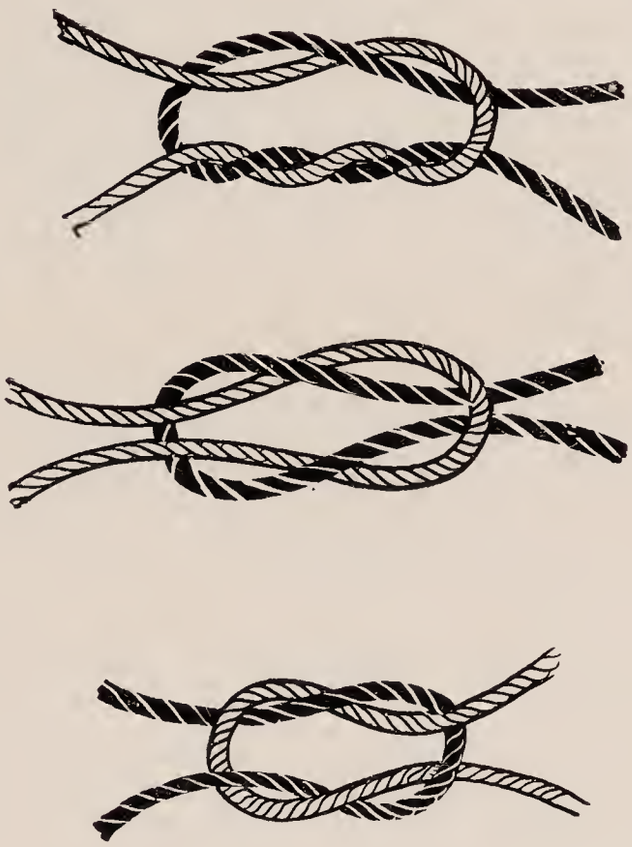


FIG. 48. Surgeon's Knot.
Flat Knot.
Granny Knot.

more likely to slip than a square knot, but while its inadvertent application is a surgical inelegance it need ordinarily cause the assistant no worry, when only a small vessel is concerned, provided that it has been drawn tightly.

The "surgeon's knot" differs from the square knot, in that the first loop is made by carrying one end of the ligature twice around the other end. This loop, when tightened, is less apt to slip during the formation of the second one than is the first loop of the square knot, which latter is quite sufficient, however, for most of the bloodvessels to be tied. A third loop may be added when in doubt as to the security of the second one.

"Mass ligatures" are applied in the same manner, but it must be remembered that it is unsafe to tie many vessels in one mass. If the surgeon employs a "Staffordshire knot" to secure a pedicle, (usually an ovarian pedicle), the assistant should grasp the loop of silk after it has been thrust through, and draw it over the ovary or other mass and over *one* of the two free ends of the ligature, which are then tied together after drawing them tightly to constrict the pedicle with the loop. Rubber ligatures, as applied to the renal vessels in nephrectomy, are secured by tying a strand of stout silk firmly about a *single knot* of the rubber, tightly drawn. Pedicle ligatures should not be cut shorter than half an inch from the knot. Whatever the size of the mass to be secured, it is worse than foolish to tighten any ligature by seizing its ends in the whole hands and pulling these far apart, for such a procedure will cut through almost any ligature (to say little of the assistant's hands themselves). It is far better to seize the ligature ends between the thumb and forefinger of each hand, and bringing the tips of these close to the knot and to each other, thumb nail to thumb nail or finger nail to finger nail, to exert a steady traction or a series of tractions.

Assistance in applying the "chain ligature," as used, for example, upon the omentum, is rendered in the following way: The tissue is lifted up and spread out evenly in an assistant's hands. When the operator thrusts through the omentum at a point near its edge (determined by the number and position of the bloodvessels) a pair of dressing-, or anatomical-, forceps, the assistant inserts in its beak the ends of two stout (catgut) ligatures, which are drawn through, and the corresponding ends of one of these (easily determined by a seesaw motion on the strands) are tied tightly around the free edge of the omentum. Then when the operator again transfixes the tissue the assistant places in the forceps a third ligature and "his end" of the second one. After the second strand is tied and the omentum again pierced, the surgeon receives from the assistant a fourth ligature and the other end of the third one, and so on. When the ligatures are all tied they are to be lifted up in a row, to indicate the

line of amputation, after the performance of which their free ends are to be cut.

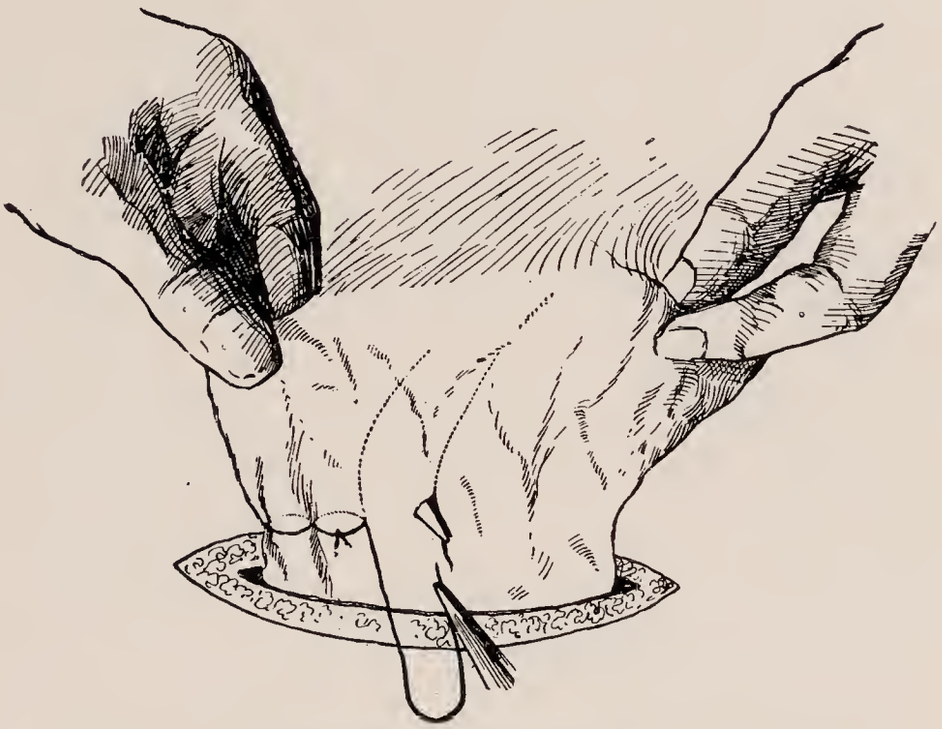


FIG. 49. Application of "chain ligature" to omentum.

SUTURING. The assistance to be rendered during suturing consists in exposing the edges to be united and in securing their accurate coaptation. When it is convenient to do so, it is helpful to lift up the two edges, and, if they be of the skin or muscular aponeuroses, to put them more or less upon the stretch. This is not always possible with deep-seated structures, *e. g.*, the peritoneum, and when it is not the assistant must content himself with lifting with his forceps the exact bit of tissue through which the needle is to pass, or exposing it so that the operator can lift it up. When, however, the edges can be stretched this may be done by inserting a small hook in each angle of the wound, or by pinching up both edges at the angles with mouse-tooth forceps. After the first knot of an interrupted or continuous suture has been secured at one end of the wound the end of the suture beyond the knot may be drawn up as a guy-thread, and the hook or forceps abandoned. When interrupted sutures are being inserted in tissues under tension the margins to be

united should be held together with forceps by the assistant as each knot is being tied. After tying, the suture may be cut

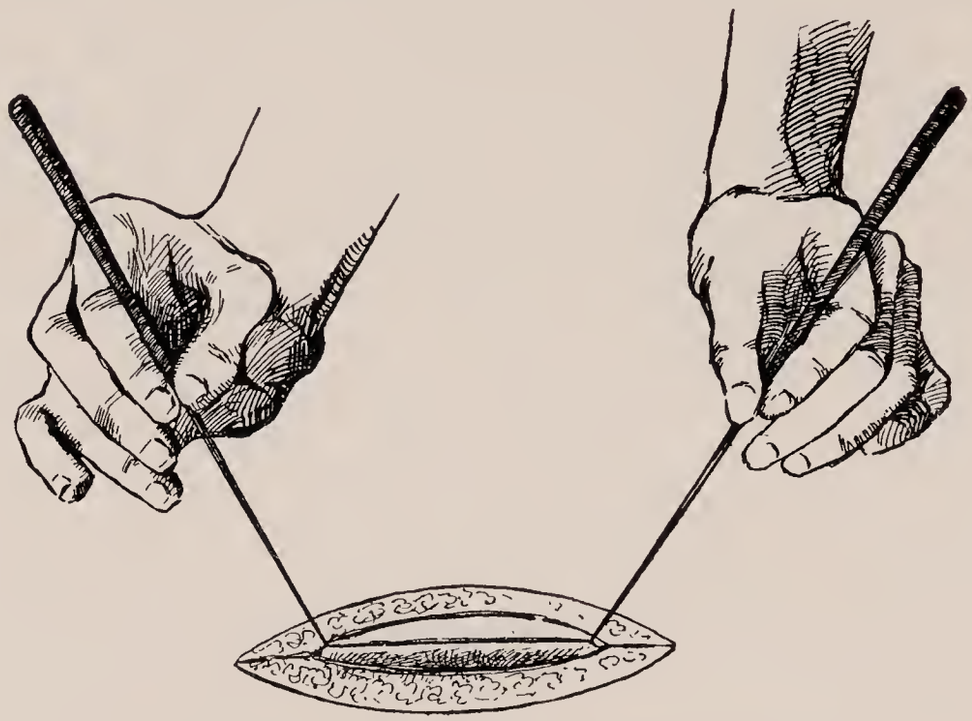


FIG. 50. Coaptation of edges by traction with tenacula.

short, or one or both ends " cut long," and drawn up with the

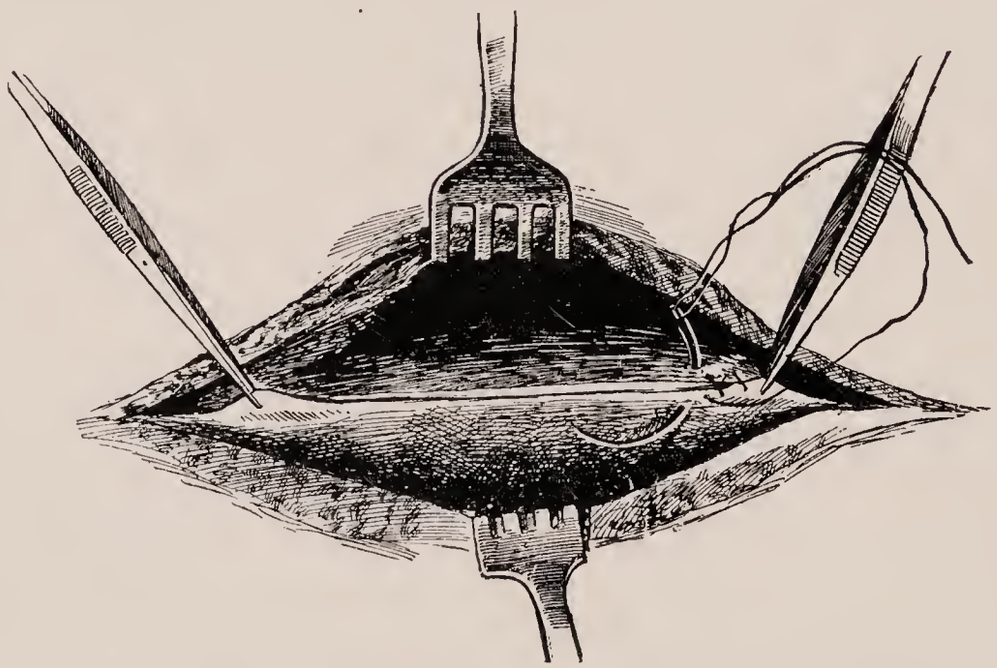


FIG. 51. Coaptation of edges by traction with two forceps.

first one in an assistant's hand until all the sutures of that row are in place. The adaptation of edges during the intro-

duction of a continuous suture is maintained by the assistant by holding taut the proximal (loose) end of the thread near its emergence from the tissues,—releasing it, to secure a new hold, as the next suture is drawn down upon the line of union (Fig. 52). The final knot of a continuous suture is made by leaving the last loop only partly drawn through and tying to it the emergent end of the suture, still attached to the needle; or, by drawing the final loop tightly but *double,* the free end on one side being then tied to the double (needle)

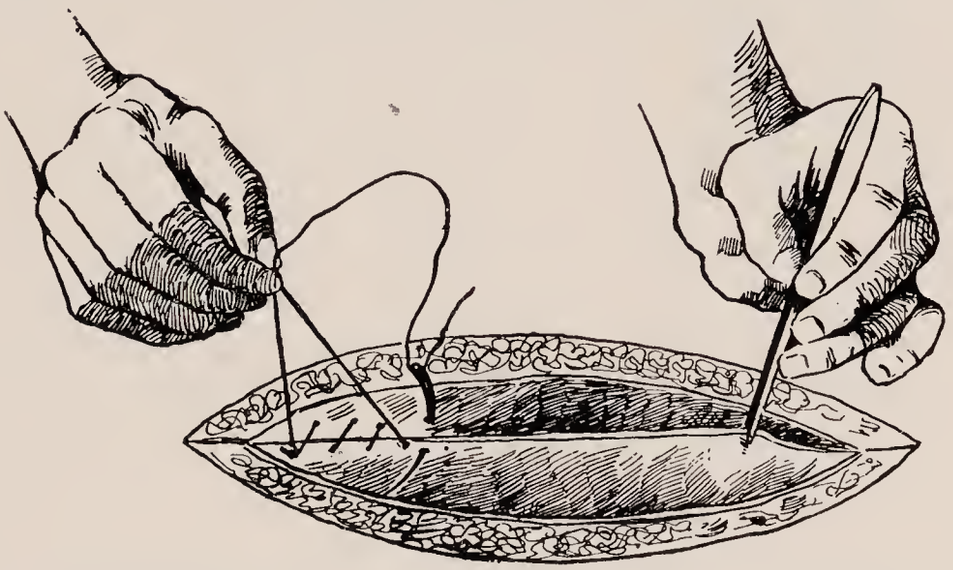


FIG. 52. Assistant's manipulations during introduction of continuous suture.

end on the other. When the suture has been secured the ends should be cut short and the needle replaced upon the instrument table or left elsewhere within plain view. Skin edges may frequently be sufficiently adapted during suturing, with a single pair of forceps (Fig. 53), and looser folds of skin may be pinched together by the assistant's fingers, at each end of the wound, a continuous suture holding well enough in place when there is no tension.

To prevent inversion and overlapping, skin edges should be carefully coaptated by the assistant. This is to be done by means of mouse-tooth forceps, everting the edges of the wound as they are brought together (Fig. 54). It should be remembered by the assistant, when he applies sutures himself, that the further from the edges they are inserted the more the latter are inverted; and that by shifting the inser-

tion to the skin edge itself, or far from the edge, he can overcome a tendency to inversion or eversion, respectively. Sutures that he applies in fascia should not be close together nor very tightly drawn, lest they cause necrosis.

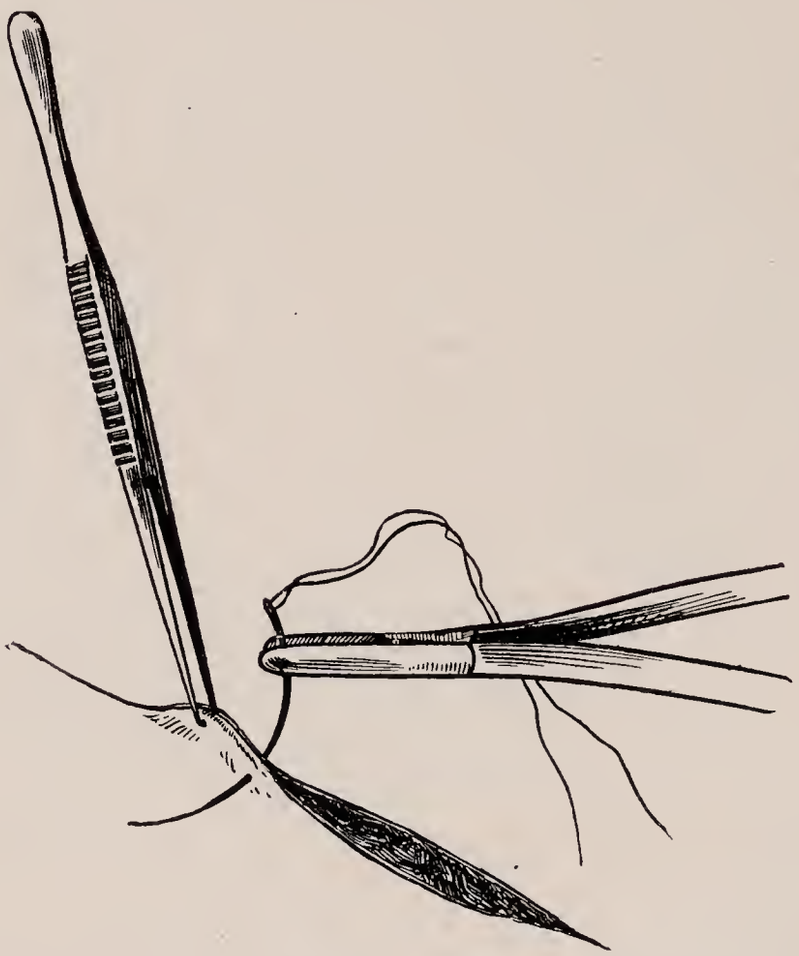


FIG. 53. Lifting skin edges with one forceps for introduction of suture.

The special assistance needed in the application of button, shot and quilled sutures has already been described (page 119).

REMOVING SUTURES. The suture is lifted up with forceps on one side at, or near, the knot, in a manner to drag out of the skin on that side a short segment of the loop that was buried in it. With scissors this freshly exposed segment is divided close to the skin itself. By this manipulation, when the suture is lifted out, its track is not infected by pulling through it any of the unburied portion of the loop.

IRRIGATING. Even though the tubing of the fountain syringe or irrigating jar is sterilized before the operation, it

is difficult to keep it so for any length of time and, therefore,

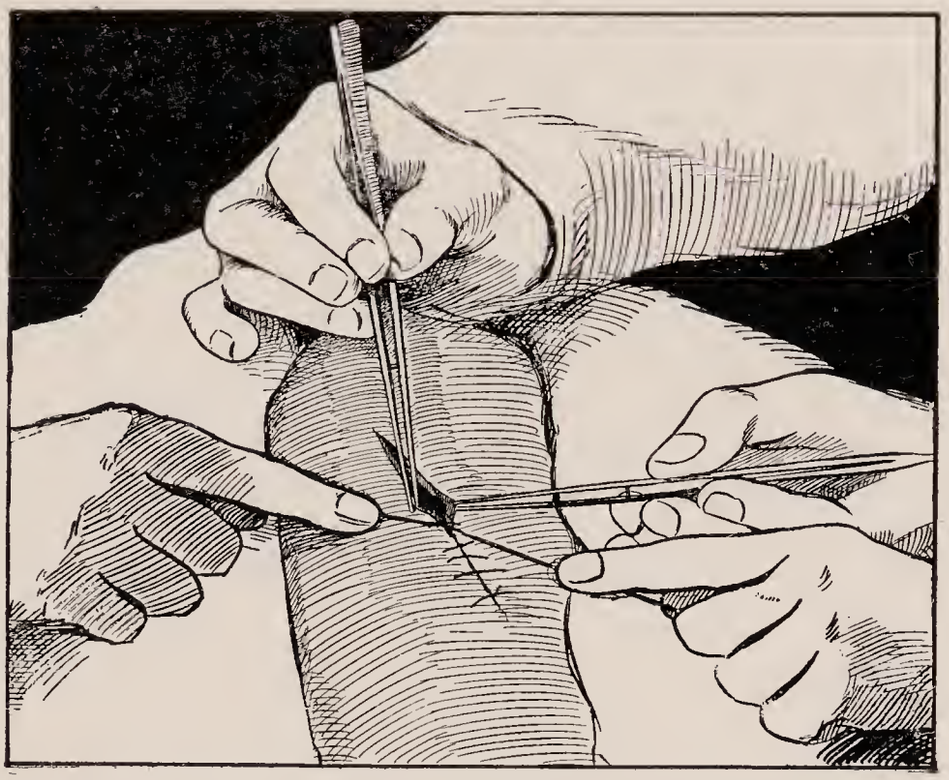


FIG. 54. Eversion of wound edges during suturing.

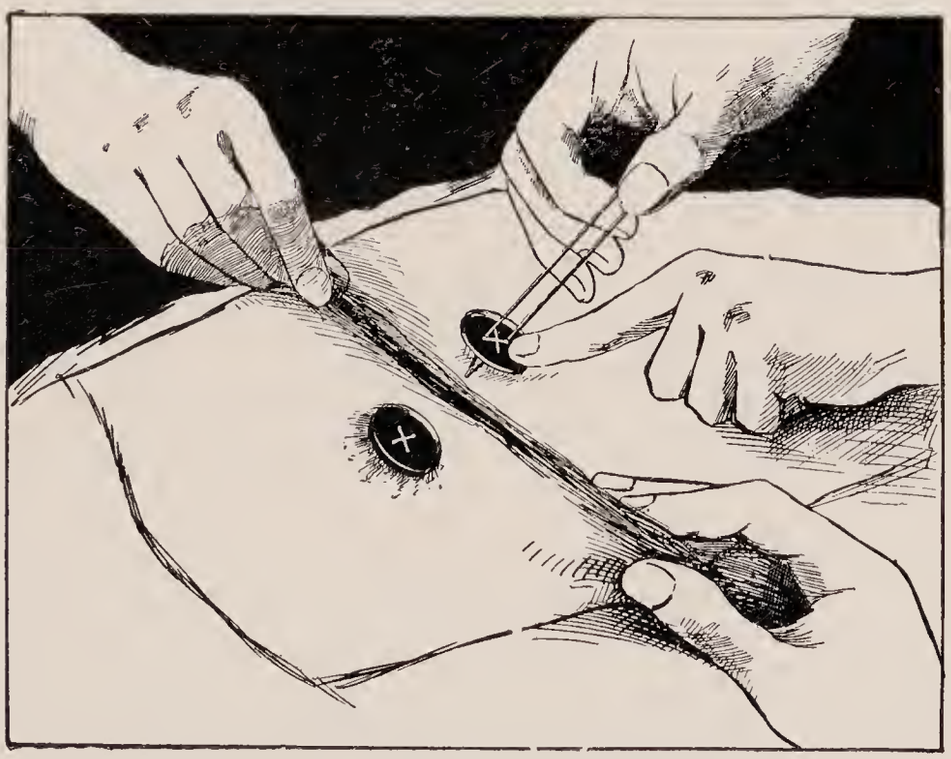


FIG. 55. Tying button sutures.

if the assistant himself will be called upon to irrigate, he

should have ready a separate irrigating tip and short segment of rubber tubing. This he attaches to the longer tubing whenever he needs it, and removes it immediately after.

The fluid to be prepared will depend upon the needs of the case. Thus, it may be water, saline solution, strong or weak sublimate solution, etc. The manner of irrigating also must be varied. If its purpose is simply to keep the operating field clear, as in plastic operations upon the perineum, the tip is held just above, but close to the wound, and a short stream, under slight pressure, is intermittently discharged. When a cavity is to be washed out, however, the irrigation should be continuous and more or less forcible, but so directed that it produces no splashing. The force of the stream is regulated by the height of the reservoir, and may be further varied by pressing upon the rubber tube with the fingers or with a pinch-cock. To irrigate the abdominal cavity, the saline solution should be poured from a pitcher.

CHAPTER X

IMMEDIATE POST-OPERATIVE CARE OF THE PATIENT.

As soon as an operation is concluded and the dressing is applied, the patient's shirt should be drawn down and a blanket wrapped about him. If, in spite of the precautions noted on page 69, the shirt has been much wet during the operation, it should be replaced by a fresh one on the table, to avoid chilling of the patient and soiling of the bedclothes. To put a nightshirt on an unconscious subject is facilitated by employing a little system. After the soiled shirt is drawn over the head and the skin is thoroughly dried, one of the patient's arms is pulled through a sleeve of the clean shirt, the body of the garment, rolled up, is drawn over his head, the other sleeve is adjusted, and then the shirt is pulled down over the trunk. If the patient is very heavy, it may be necessary to split the shirt through the back and put it on in the manner in which the surgeon dons his gown. When the patient's condition forbids the delay and exposure incident to a change of garments, he should simply be wrapped in a blanket, and thus carried to bed.

The transportation from table to bed is conducted on a stretcher—for which an ironing-board may be made to serve—or in the manner, and with the precautions, described on page 68. Often the operating table can be rolled alongside the bed and the patient lifted off, or slid off by tipping the table.

A nurse, if not a physician, should remain with the patient at least until he is well "out" of the narcosis. Sometimes the surgeon will deem it necessary for the assistant himself to watch the patient for several hours after an operation. It is therefore important to consider here some items that may require his attention.

The Room should be well ventilated, but not cooled below a temperature of 68° to 70° F. The light is to be subdued, but not so much excluded that the patient's features cannot easily be watched. Quiet is to be maintained and, as a rule, the family is to be excluded.

The Bed must be prepared in advance. The upper sheet is removed so that, for the first few hours, the patient lies beneath, or even between, blankets. The lower sheet is smoothly drawn, and across the middle of it is evenly laid a piece of rubber sheeting or oilcloth about a yard wide. Over this, and of the same width, is tightly pinned a "draw sheet," consisting of unbleached muslin or of an ordinary sheet doubled over. In order that the patient's head shall be low, the pillows are removed entirely, or a single flat pillow is allowed. Over it are spread towels, and a basin is laid near-by—these to provide for vomiting. The bed is to be made warm by the use of several bags or bottles of hot water; but these should be removed before the patient arrives, or at least it should be determined that the bags are not hot enough to produce a burn, or that they are very well covered with towels or flannnel.

The Patient must be laid in an unconstrained position, *i. e.*, one that does not threaten pressure-paralysis of an extremity. If one of the limbs has been operated upon, it is placed on a pillow, to which it may be secured with pins or bandages. Pressure of the bedclothes upon it is avoided by placing over it a regular "cage," or one devised from barrel-hoops or a box, or by such other means as will suggest themselves.

The patient's temperature should be noted soon after the operation, and at two- to four-hourly intervals thereafter. The pulse should be studied as frequently as the patient's condition may require.

Pain and Restlessness usually come with returning consciousness, and frequently call for the hypodermatic injection of morphin, with or without atropin.

Tightness of the Dressing is often an early complaint of the patient. If inspection prove it to be indeed constrictive, the pressure must, of course, be relieved—by nicking the

bandage or by reapplying it. When plaster of Paris has been employed, the extremity is to be watched for evidences of compression. Swelling or cyanosis of the parts beyond the cast is an indication that it is too tight. Slight congestion of the digits is not necessarily an indication of undue interference with the circulation, however. If the anemic spot under the nail, produced by pinching with the fingers, is *quickly* restored to its original color when the fingers are withdrawn, the circulation in the part is not much interfered with. When the edge of a cast is found to be pressing into the flesh, it must be cut away or lifted up with a little cotton wool.

Vomiting is the usual sequel of narcosis by ether or chloroform, but it is not constant in its duration or severity. Occurring before the patient is "out," the head is to be turned well to one side, and the jaw extended; and, afterwards, the buccal cavity is to be wiped out. Occurring after the reflexes have returned, the patient need only be encouraged to "spit out" whatever vomitus remains in the throat. The vomiting tendency can sometimes be much relieved by holding over the nose an inhaler or handkerchief wet with vinegar. When the emesis is unduly persistent, tincture of iodin given in one-drop doses in a little water at half-hourly intervals may prove quite useful. Morphin, too, often relieves, but also often aggravates, vomiting.

Feeding. After the administration of ether or chloroform, no nourishment should be given by mouth for a period of six hours (more or less, depending upon the condition of the patient and the nature of the operation), and then only if the vomiting has ceased and nausea has largely disappeared. Frequently a little water may be allowed after four hours; and with children feeding can usually be resumed sooner than with adults.

During the interval of abstinence, dryness of the mouth may be relieved by wetting the lips with water; and pellets of ice may be administered from time to time after the first hour or two if the vomiting has stopped or much diminished. For dryness, also, chewing-gum is frequently allowable to stimulate salivary secretion. Hot tea for adults, and milk and

lime-water for children, given by the teaspoonful, are, as a general rule, the best articles with which to inaugurate feeding.

Singultus occasionally occurs during the first hours after an operation. In mild cases it usually responds to such measures as "holding the breath," or the application of a mustard paste to the epigastrium, or the administration of hot water or of carminatives (aromatic spirits of ammonia, compound spirits of ether, compound tincture of cardamom, etc.) When more severe it frequently yields to morphin, while in still more persistent cases belladonna (the tincture by mouth, or atropin hypodermatically) usually proves the most effectual single remedy. Rhythmic tongue traction is also of help. Faradaization of the phrenic nerve and other measures recommended for long-continued hiccough scarcely need consideration in the treatment of immediately post-operative singultus.

Urination. The patient should be instructed to empty his bladder just before the operation. For a longer or shorter period after an operation, especially one involving the perineal region (the anus and urethra, in particular), the patient often finds himself unable to urinate. Ordinarily, a period of nine hours may be allowed to elapse. If during that time micturition has not taken place, it can frequently be brought about by the injection of a half pint of warm water into the rectum, the application of a hot-water bag to the hypogastrium or [and] the administration of sweet spirits of nitre in teaspoonful doses at half hourly intervals. In those instances where there is no objection to the patient sitting up in bed, the assumption of this posture may be found all that is necessary to accomplish evacuation of the bladder. The sound of running water acts as an active stimulant to urination; and it must be remembered, too, that the presence of another person in the room is often a decided inhibitory factor, especially with nervous and sensitive patients.

If these various methods fail to accomplish urination, catheterization must be performed (pages 244 and 255). After plastic operations upon the vagina or perineum, the

bladder is to be emptied with the catheter at regular intervals of six hours or, at least, to prevent infection of the wound, it is to be washed off with some antiseptic solution after each urination (and defecation).

Shock and Hemorrhage. These two conditions have certain symptoms in common, and while an external hemorrhage is readily discovered, the tragic error of mistaking for mere shock a *concealed hemorrhage* can easily be made by the unwary. Progressiveness of the symptoms, while it may be present in shock, should in itself arouse strong suspicions of the existence of a continued hemorrhage. But the other means of differentiation are not few if the evidences are carefully studied. The better to contrast these evidences, they are presented in parallel columns:—

	Shock.	*Concealed Hemorrhage.*
Symptoms in general	Often regressive	Always progressive!
Local symptoms	Absent	Often present, *e.g.*, cough; localized pain or tenderness; abdominal distention; vomiting; hematemesis; hematuria; etc.
Mentality	Dull; stuporous	Active
Restlessness	Slight	Often great
Pallor	Moderate	Very marked—especially of mucous membranes; progressive
Sweating	Frequently present	Usually absent
Respiration	Rapid	Marked and increasing "air-hunger"
Pulse	Rapid and weak	More and more rapid and weak
Effect of intravenous infusion	More or less lasting	Transitory
Effect of other stimulants	" " "	"
Temperature	Variable; may be subnormal	Often markedly subnormal
[Specific gravity of the blood	Increased*	Decreased]

Treatment of Shock. The pillow is removed from beneath the patient's head, and the foot of the bed is elevated by means of bricks, boxes, etc., or upon a chair in the manner illustrated in figure 56. The patient is wrapped in blankets warmed in an oven, and surrounded with hot water bottles. Friction may be applied to the extremities. To raise the

* Vale—Medical Record, August 27, 1904.

general blood-pressure, the limbs may be bandaged tightly, beginning at the digits; and this compression may also be applied to the abdomen, taking care, however, not to embarrass respiration.



FIG. 56. Elevating the foot of a bed with a chair. Note flat pillow, towel, draw-sheet.

The judicious employment of stimulants cannot be taught in a text-book but must be learned at the bedside. The inexperienced assistant is apt to use them too freely, which, however, is a less serious fault than using them too little.

Strychnin (gr. 1-30 injected hypodermatically, and repeated in an hour, if need be), may be all that is necessary. Other remedies may be required, however, and of these the most serviceable are whiskey (♏xxx hypodermatically, and repeated at intervals of fifteen minutes to three hours), digitalis (♏x of the tincture, ♏iii of the fluid extract, or gr. 1-60 of digitalin *), adrenalin (♏x of $\frac{1}{10}$ per cent. solution adrenalin chlorid every two hours), caffein (gr. ii of the sodio-salicylate or the sodio-benzoate), ether (♏xxx) and camphor (gr. i dissolved in olive oil or oil of sweet almonds, or in ether). A "stimulating enema" (page 93) is a powerful restorative also, in those cases especially where the shock is

* There are several preparations of digitalin, and the dose is not the same for all of them.

in large part due to loss of blood at the operation. In cases of severe shock not yielding to the above agencies, an intravenous infusion (page 301) may prove a life-saving measure.

Treatment of Hemorrhage. Here stimulants serve to augment the bleeding, and their use should therefore be reserved until after it is checked. This is stated only as a general rule, however, for in the presence of severe hemorrhage stimulation may be quite necessary to maintain heart action during the time that must elapse before the bleeding vessel can be secured. Intravenous saline infusion (page 301), strychnin, digitalis and adrenalin are the most useful stimulating remedies. A small dose of morphin may be indicated primarily as a sedative and incidentally as a stimulant. Ergot (ergotole or aseptic ergot, hypodermatically) is only an adjuvant in the treatment of hemorrhage, and is of no avail when the bleeding is from a large vessel.

External hemorrhage is often controllable by means of compression, as by a tight bandage, adhesive straps or sandbags. To check bleeding from a wound in one of the extremities, the assistant should apply a tourniquet (page 289); while in other instances manual compression of large blood-vessels, *e. g.* the abdominal aorta, may serve to hold the hemorrhage in check until the surgeon himself arrives.

When such means as above described are not available, and the surgeon in charge is not within immediate call, the assistant himself must promptly attack the bleeding vessel or surface, wheresoever it may be:

Bleeding from Wounds in General. Retract widely and sponge free of blood-clots. Tie individual bleeding vessels, if accessible. Treat general oozing by tight packing with gauze (dry, iodoformized, is considerably more hemostatic than plain gauze), and a compressive bandage.

From the Anterior Naris. Plug with gauze strips or with cotton, and apply ice compresses to the nose. The application to the mucous membrane of adrenalin solution (1-2,000 to 1-5,000 suprarenal extract) or powdered antipyrin is of great assistance. Cocain, too, is astringent as well as anesthetic. It must be borne in mind, however, that the reaction after the

effect of these drugs passes off may be very severe, and the tamponade must therefore be none the less careful when they are used.

From the Posterior Naris. Pass a catheter or probang through the nostril to the pharynx and draw its tip out through the mouth. To this tip fasten with a clove-hitch one end of a string six or eight inches long, to the other end of which is secured a plug of gauze. By pulling upon the catheter the string is drawn forward through the nose, and the plug is brought up to the posterior naris.

From the Tonsil. Treat by the following measures, in order, and according to the severity and persistence of the bleeding: upright position with avoidance of hawking and coughing; ice in the throat and ice bag externally; application of adrenalin by swab or spray; pressure upon the tonsil with a gauze pad which may be coated with suprarenal extract or other hemotastic; digital compression of the tonsil and of the common carotid artery, or, better, compression of the gland, internally and externally, with a special tonsil clamp; clamping and ligation of accessible spurting vessels; transfixion- or purse-string-suture of the tonsil; ligation of the common carotid artery.

From Intercostal Vessels. Expose the wound and press between, and well beyond, the ribs the centre of a "handkerchief" of gauze. Into the bottom of this pocket pack a strip of gauze. Then pull on the "handkerchief" in order to wedge the vessels tightly between the rib and the wad of gauze. If this fail, pass a hemostatic suture, by means of a half-curved needle, close to the edge of the rib above and around the intercostal tissues.

Intra-abdominal Hemorrhage. Prepare hastily, *i.e.*, without *unduly* sacrificing the important element of time to the now secondary consideration, asepsis—towels, sponges, gauze pads, ligatures and sutures, a large pitcherful of hot .9 per cent. saline solution, mouse-tooth forceps, scissors, [scalpel], sharp and blunt retractors, needles and needle-holder, ligature-carrier, clamps, artery forceps and sponge-carriers. Place the patient upon a stretcher or table, and

open, or re-open, the abdomen. Sponge out obstructing blood clots and seek the bleeding vessel or vessels, the probable location of which is indicated by the nature of the primary operation. Clamp firmly and apply ligatures or hemostatic sutures. Pour the saline solution, at a temperature of about 105° Fahr., into the abdominal cavity to wash out the remaining blood, and leave about a quart of the solution within the peritoneal sac. Close the wound by "through and through" sutures of silk or silkworm-gut.

If the hemorrhage be from a vessel in the *gall ducts*, the assistant will do best to simply apply a strong but narrow clamp, and insert gauze packings about it, leaving both the instrument and *all* the gauze strips protruding from the wound. Bleeding from the *liver* itself is difficult to control. Clamps and sutures often tear through, and the actual cautery may also avail nothing. In such instances apply gauze packings and a firm, compressive dressing. Cholemia, often present in conditions requiring operation upon the biliary tract, is a pronounced hemorrhagic factor, and so packing and even ligating may not in themselves suffice to control the bleeding. When it is thus persistent, strong and continuous manual pressure directly over the dressing must be maintained for many hours.

From the Kidney (after nephrotomy). Retract the wound and have the nurse or other helper push the organ into it by pressure from in front (figure 84). Sponge out the wound in the kidney and pack it with gauze; pack also around the kidney. If this fail to check the bleeding, which is unlikely, pass heavy catgut sutures through the substance of the organ.

From the Renal Pedicle (after nephrectomy). Search with a finger in the opened wound for the renal artery, and seize the vessels in a clamp directed along the finger. Leave the instrument in the wound and pack gauze around it. If the pedicle cannot be reached, open the abdomen promptly and ligate or compress the renal vessels transperitoneally.

From the Bladder. Place the patient in the Trendelenburg position in such a manner as to direct a good light into

the bladder. If necessary, insert gauze above the fundus to protect the peritoneal cavity against soiling. Open or reopen the bladder and retract the wound with guy threads or forceps. Sponge out blood clots and pack the viscus systematically and tightly with gauze strips. Individual vessels may be secured by hemostatic sutures, while light touches of the actual cautery are of aid in stopping the hemorrhage from a larger or smaller surface.

Gauze packing may fail to stop the bleeding from large vessels at the base of the bladder. In such a case employ the following device: Transfix several small superimposed squares of gauze with a double strand of heavy silk, or of twine, about six inches long. Carry the silk directly through the perineum, either by means of a heavy needle or with forceps, and pull upon it so as to bring the gauze tightly against the bleeding surface. Fasten the silk to the external dressing or to the thigh.

From the Perineum (after prostratectomy, urethrotomy, cystotomy, etc.). Retract the wound, tie individual vessels, secure the drainage tube in position, pack gauze strips about it and apply a compressive dressing.

From the Rectum. If the hemorrhage is moderate, insert a *large* "tampon-canula" (page 279). If the loss of blood be large or continue in spite of the tampon, introduce a speculum, clamp and tie bleeding vessels and then insert the tampon-canula. In some instances, as in bleeding after the division of a stricture, a "canule à chemise" will prove more effective than the tampon-canula. The use of a tube, instead of packing the rectum with gauze alone, has the advantages of making continued hemorrhage manifest by the escape of blood into the dressing, and of permitting the passage of flatus.

From the Uterus (post-partum). Administer by means of a Chamberlain tube or other uterine irrigation tip, a copious hot (115° Fahr.) douche of .9 per cent. saline, or 1-10,000 sublimate solution, or of plain water to which may with advantage be added half an ounce of acetic acid to each quart. Stimulate contraction of the uterus by pressure on,

and manipulation of, the fundus, and by the administration of ergot. If these measures fail, pack the organ systematically with long strips of gauze. Continue pressure upon the fundus for one hour.

From the Cervix Uteri. If hot douches and gauze packings are insufficient, pass a hemostatic suture.

The after treatment of severe hemorrhage is that of shock due to any cause, described above. The use of saline infusions is especially indicated.

Pulmonary Edema manifests itself by increasing dyspnea and cyanosis, by moist râles that become louder and louder and more diffused over the chest, and by the appearance, a little later, of a profuse cold sweat. The treatment must be prompt, vigorous and persistent. Nitroglycerin and atropin, administered hypodermatically in large doses (gr. 1-50 of each) and repeated to the physiological limit, are the most important remedies. Stimulants, notably strychnia, are also indicated to assist the heart in overcoming the pulmonary stasis. A small dose of morphin (gr. $\frac{1}{6}$) may be of much service. Oxygen is often of real use and, at any rate, should be sent for early lest the assistant otherwise subject himself to the unfriendly criticism of the patient's family. The gas should be allowed to escape from the tank only in sufficient volume to bubble at a moderately rapid rate through the bottle of water. The tip of the tube attached to the bottle is held in the patient's nostril.

All the mechanical methods of abstracting and diverting blood from the lungs must be brought into play. The head of the bed is to be raised. *Cups* should be applied freely to the chest both anteriorly and posteriorly. Lacking the regular cupping glasses, medicine- and wine-tumblers make very acceptable substitutes. The method of using them that minimizes the dangers of burning the patient and of igniting the bedclothes, is the following: A torch is made by winding a little cotton about the end of an opened hairpin or of a probe. This is dipped in alcohol and lighted, then rubbed rapidly about the interior of the cup, which is to be promptly clapped on the chest. " Bleeding the patient into himself " is

accomplished by applying constrictors to the limbs near their roots, one or two extremities at a time, and for periods of not over half an hour each, the constriction being only tight enough to compress the veins without obstructing the arterial supply. When the tourniquet is properly applied, the superficial veins dilate visibly, and the extremity becomes cyanosed and swollen. Hot applications are to be made to the limbs not at the time being constricted.

Actual blood-letting *(phlebotomy)* is indicated only in plethoric individuals. The arm is prepared and bandaged, as described for intravenous infusion, and the vein is exposed in the same manner. There are these differences, however, that the distal ligature is not tied in advance (the proximal ligature may be) and that the bandage is not cut through until after the operation is completed. The vein is opened with a scalpel or with scissors. A towel or basin held above the wound when the vein is opened prevents soiling of the bedclothes. If the exposed vein segment is compressed digitally above and below until after it is opened, and a canula is inserted (towards the patient's fingers), spattering is avoided and the blood may be directed neatly into a glass graduate. Six to twelve, or even sixteen ounces, may be withdrawn. When sufficient blood has been sacrificed, the vein is again compressed with a finger, the ligatures are tied and the vessel is divided between them, the bandage is cut through, and the wound is rapidly dressed with a bit of gauze.

Uremic (Eclamptic) Convulsions. A wedge or gag is to be slipped between the teeth to prevent injury to the tongue. A handkerchief or mask well wet with chloroform is held over the face so that the patient inhales the vapor as soon as the respiratory spasm subsides. With the chloroform the convulsions are controlled, either by keeping the patient in a state of mild narcosis, or by applying the mask the instant a recurrence of twitching appears. The rest of the immediate treatment consists in reducing the arterial tension and in securing activity of the emunctories. Hot packs, consisting in wrapping the patient in blankets wrung out in very

hot water, are to be used freely. Vasculo-dilators, *e. g.*, nitroglycerin, are also to be employed. If a reliable preparation of veratrum viride is obtainable, a hypodermatic injection of ♏iii of the fluid extract or ♏v of the tincture may be administered, and this the assistant may repeat in two or three hours if the first dose has not effected softening, enfeeblement, or irregularity of the pulse, or reduction of its rate below ninety. Phlebotomy *(vide supra)*, followed by intravenous or rectal saline infusion, is indicated if the patient is not anemic or has not already lost much blood.

Poisoning by the Absorption of Antiseptics seldom gives symptoms within the first few hours after operation, and will, therefore, be but briefly considered.

Carbolic acid absorption produces pallor, labored respiration, drowsiness deepening into coma, and collapse; pupils normal or contracted; urine olive-green. Treat by changing the dressing and irrigating the wound and by administering stimulants and diuretic agencies.

Poisoning by bichlorid of mercury produces salivation, diarrhea, vomiting, rapid and feeble pulse, sometimes suppression of urine. Change the dressing, wash the wound, administer water and purgatives.

Iodoform poisoning. In mild cases there are produced a vivid rash about the wound, mental excitation and the iodin reaction in the urine. In severe cases the cerebral symptoms are marked—delirium or mania, but sometimes coma—and the scarlatiniform rash spreads over other parts of the body; pyrexia develops, the pupils become contracted and the pulse is rapid and feeble; collapse may supervene. Remove all iodoform from the wound, and employ symptomatic treatment. Carbonate of potash is said to be an antidote to iodoform, and may be used both locally and internally.

PART II.

PART II.

CHAPTER XI.

OPERATIONS UPON THE HEAD.

THE CRANIUM.

Trephining.

The anesthetist, as for all aseptic operations upon the head and neck, should wear a sterilized gown and a cap, and should disinfect his hands. All of his tools should be sterilized or covered with aseptic gauze. In addition, it is wise for him to so place a sterilized towel that it will safeguard against contact between the operators' hands and his own. The narcotizer should stand or sit at the side of the table opposite to the operator. He will usually be least in the way if he seats himself opposite the patient's chest. It is worth repeating here that he should guard the patient's eyes from any inadvertent pressure.

The instrument hander arranges his tools in about the following order: scalpels, mouse-tooth forceps, anatomical forceps, hemostats, scissors, retractors, periosteal elevator, raspatory, trephines (the adjustment of the central pins of which is to be inspected), bone-seizing forceps, De Vilbiss or other bone-cutting forceps, [Gigli wire saw], rongeurs, sharp spoons, chisels, gouges, mallet, probes, [bullet searcher], [aspirating syringe], needle holder. In the dishes he arranges a number of fine and medium-sized catgut ligatures, and sutures appropriate for the meninges (fine catgut) and for the scalp (silk or catgut). From a dish of sterilized Horsley's wax a few plugs are removed with a spoon and placed within ready reach; and in addition the assistant places on his

table some gauze packings and a piece of rubber tissue prepared as previously described.

If an electric or other motor is to be used for driving trephines or burrs, as much of the apparatus as may come within the field of operation should be covered with gauze (wound about it). Similarly, the instrument hander should cover the rheophores of an electric battery that may be used on the brain and, it need hardly be said, he should sterilize the platinum electrodes.

The patient is placed with his head well supported on a towel-covered, flat or wedge-shaped, pillow at one end of the operating table, so disposed as to secure the best light in the wound. Below should be a slop-pail. If the scalp has not been already prepared, it should now be shaved, either completely or, at least, over a wide area. The skin is then to be disinfected, as described in chapter V. It is well to include the face in this toilet in order to minimize the contamination of the anesthetist's hands. A fresh towel is next spread over the pillow, removing the first one if it is wet (as it is apt to be). If a Martin's constrictor is to be employed, it should be applied at this juncture, being passed circularly about the head, just above the auricles and the eyebrows and just below the occipital protuberance, and secured at the point of crossing with a piece of bandage. Towels are now spread freely about the field of operation, and the head is turned so that this site is uppermost.

After passing scalpel and mouse-tooth forceps, the instrument hander should be ready with hemostats. He should select the Hartley T-shaped or Spencer Wells pedicle clamps, if they are provided, for the scalp bleeds all along the cut surface and, besides, ordinary hemostats are not here easily retained. Although the T-clamps, gripping as they do the entire thickness of the scalp, may be used as retractors, it is perhaps better for the assistant to insert the usual instruments for drawing aside the skin-flap. What will next be required of him will depend upon the nature of the operation. If it is *for depressed fracture* there should next be passed a probe and a periosteal elevator. After these no other instru-

ments may be needed than bone forceps [and scissors] for removing fragments, rongeurs for smoothing off projecting bone edges, sutures for the external wound, and a "cigarette" or other drain. Utmost gentleness and caution must be exercised when sponging over a fractured cranial bone. If the trephine is used, the assistant should support the head and, as opportunity offers, sponge away the bone dust. As the operator removes the trephine from time to time, there should be placed in his hand a fine probe, with which he may test the depth of his cut. If the button of bone does not happen to come away with the final removal of the trephine, an elevator is given to the surgeon to pry it out, after which a probe is again handed to explore the epidural space.

When, in operating for any *cerebral or meningeal lesion,* or in *excision of the Gasserian ganglion,* a bone-flap is to be raised, the assistant should hand a trephine for making two or more apertures, and then instruments for connecting these openings,—De Vilbiss or other bone-cutting forceps, Gigli wire saw and director upon which to pass it, Van Arsdale saw, bone drill, or gouge and mallet, according to the operator's preference. After the [skin- and] bone-flap has been raised, it is to be retracted, preferably in a piece of gauze, by the assistant, who must exercise care not to strip the bone from its periosteal covering. Bleeding from a vessel in the bone calls for the use of a tiny plug of wood or of wax, which the instrument hander passes in the palm of his hand or in a saucer, or for the introduction into the bony channel of a heated wire (*e. g.*, one from an aspirating needle). The lifting of a bone-flap may cause severe hemorrhage from a meningeal vessel torn at a point inaccessible to forceps or suture. At its appearance the assistant should, therefore, be ready with a gauze packing.

Before dividing the meninges the operator may desire to secure some of their bloodvessels, and for this purpose he should be given a fine catgut suture on a small round needle. For the incision into the dura there are to be handed two small mouse-tooth forceps, and a pair of small blunt-pointed straight scissors or a delicate scalpel. To secure bleeding

points in the brain itself, serrefines (appendix, figure 43) should be passed, if they are provided, for, being light, they are less apt to tear out than ordinary hemostats. If the latter are used therefore, they should be supported in position by the assistant's hand until the ligatures are applied.

When the wound is to be closed the assistant gently sponges off the bone-flap and removes the T-clamps from the scalp. Vessels that then bleed, unless of large size, will be secured by the scalp sutures. These are usually interrupted and of catgut, and should be threaded on stout needles. A gauze drain may be desired.

The *dressing* should be retained by an evenly compressing recurrent bandage, and this, in turn, may well be secured with a starch-crinolin roller.

The assistant should support the head while the patient is being lifted from the table and into his bed.

MASTOID OPERATIONS.

The assistant places the patient's head on a firm, flat, wedge-shaped or cylindrical pillow, the diseased area uppermost. The hair is to be shaved from the region about the mastoid process, the rest of the scalp being covered by a towel (page 84) or a rubber cap. The locks of hair that straggle from under the cap, if the patient is a female, may be pasted back with collodion. The external auditory canal is then irrigated with a boracic acid or other antiseptic solution, and then the cheek, auricle, mastoid region and neck are to be scrubbed and disinfected. After this the towels are spread, and a bit of absorbent cotton or a narrow strip of gauze may be lightly packed into the auditory meatus.

The instruments should be arranged much as for trephining, the coarser bone tools used in that operation being replaced here by the smaller mastoid burrs, gouges, chisels and curettes (appendix, figs. 66-68). These are spread out systematically, according to their sizes and shapes. An aural hand-syringe and a basin of irrigating solution, a pus basin (sterilized or covered with a sterile towel), one or two small

saucers and a supply of bone wax should be at hand. But few ligatures need be prepared. A few sutures of silk, catgut or horsehair should be mounted on stout, full curved ("mastoid") needles. If the operation be extended into the

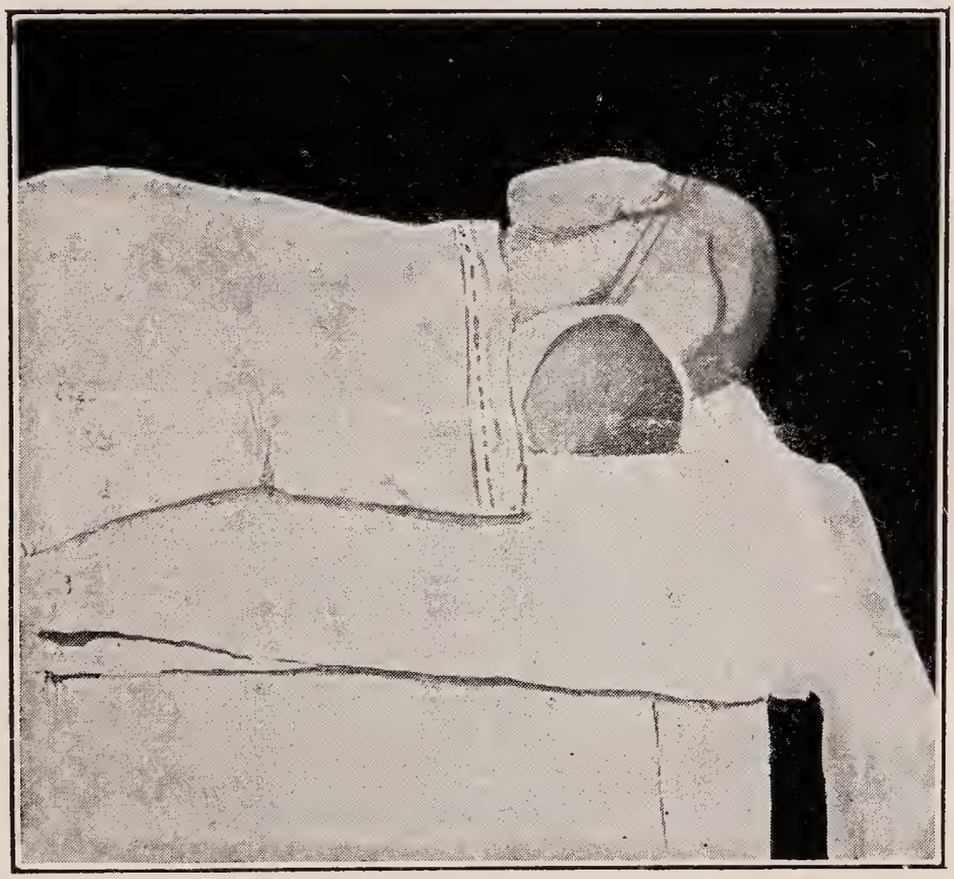


FIG. 57. Position of the head for operation upon the lower jaw or neck. For a mastoid operation the rubber cap should not be drawn quite so far down.

neck, *e. g.*, to explore the jugular vein, one or two sutures are to be threaded on ordinary surgical needles; and if a complete Stacke operation is found necessary, the assistant prepares silk sutures on small round needles for fastening the incised concha in its new position.

A generous supply of bits of sea-sponge should be torn. These should be placed in a dish, together with a pair of thumb forceps, or, better yet, several of them are securely mounted on artery forceps and their loose edges trimmed with scissors. The sizes of these sponges should be altered to suit the varying depth and width of the cavity in which the opera-

tor is working. Larger pieces may be rinsed, *squeezed dry,* and used repeatedly, but very small bits of sponge should be discarded after using once.

Sea-sponge, unless quite compact, tears on rough bone and it is well, therefore, for the assistant to prepare strips of gauze about an inch wide and six inches long and free of raveled edges. When needed for "sponging" several of these strips are placed near the wound and with them a probe for their manipulation.

A longer piece of gauze of the same width and double thickness, is to be laid aside on the instrument table for plugging the lateral sinus should it be inadvertently opened.

When the primary incision has been made hemostats are passed and after them ligatures, to be tied at once since the forceps are apt to be dislodged or to obstruct manipulations if left in situ. The insertion of retractors will stop the bleeding from most of the vessels running through the soft parts over the mastoid process.

Care should be taken not to bruise the auricle with the retractor. When the bone is reached the operator is relieved of the scalpel and given an elevator for the periosteum (unless this tissue is destroyed by the disease process). In turn this is to be replaced by an instrument for attacking the bone itself, which the assistant should select according to the preferences of the surgeon and the conditions present. Some mastoid operators depend chiefly upon chisels and gouges, while others prefer burrs. If the bone surface is normal or sclerosed a mallet is handed with the gouge; if it is eroded the gouge alone may be required; while if the bone surface is much destroyed, especially if the patient is a young child, a sharp spoon will suffice. The instrument hander should closely follow the development of the operation, so that he may forestall the surgeon's request for a larger or a smaller curette and will at the proper time hand him, unasked, a rongeur to remove a ledge of bone, etc.

Aside from holding retractors, the assistance at the wound consists chiefly in sponging and in removing bone-fragments.

The sponging must be assiduous, but none the less judicious. It would be unwise, for example, to too hastily wipe away a drop of pus that may appear, for with it may be removed

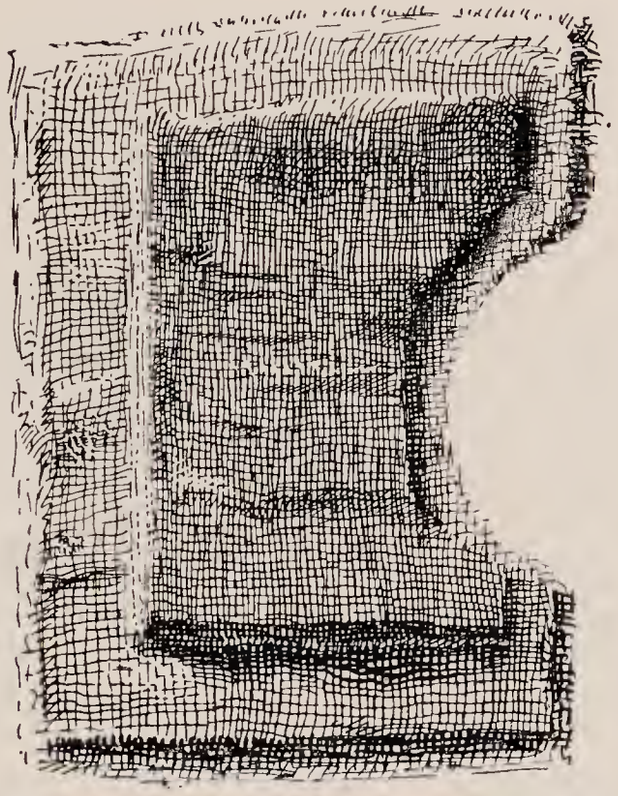


FIG. 58. Gauze to be laid over the mastoid wound, trimmed to fit against the auricle.

the early clue to a new site of operative attack. Again, if an area of brain tissue or of the sigmoid sinus is exposed, an infectious bone fragment may be thrust into it by sponging that is more vigorous than cautious.

The removal of bone fragments is better accomplished with dressing- than with anatomical-forceps. Two warnings should be given here, viz.: to avoid injury by the forceps to the facial nerve, if the Fallopian aqueduct has been opened; and to refrain from pulling upon any bone particles not altogether freed from the periosteum, without first completing the detachment with a snip of the scissors. The last is a small detail in technic, but an important one,—the tearing away of a still adherent bit of bone at the mastoid apex may bring with it a few fibres of the sterno-mastoid muscle, and thus open a channel of infection in the neck.

After the bone cavity has been cleansed and packed the retractors should be withdrawn, and any bleeding vessels secured. The dressing is then to be applied. In order that the auricle shall not be distorted the deeper layers of gauze may be trimmed to fit the posterior surface of the concha. A plug of absorbent cotton is then to be placed lightly in the auditory canal, and the auricle evenly covered with a smooth pad of gauze or cotton wool. If there is little oozing of blood and the dressing is soon to be changed, the outer layers of



FIG. 59. Mastoid dressing firmly retained and reduced in bulk by the application of a starch bandage.

gauze may be wet in a solution of salt, aluminum acetate (liquor Burowii), bichlorid of mercury, etc., and covered with gutta-percha tissue, oiled silk or wax paper. Over this is laid a thin layer of cotton wool. The bandage, two inches wide, is applied in oblique turns over the scalp and figure-of-eight turns about the forehead and neck. If a starch bandage be applied over this the neck turns may be omitted—which will save the patient much discomfort.

CHAPTER XII.

OPERATIONS UPON THE HEAD.—Continued.

OPHTHALMIC OPERATIONS.

Extraction of Cataract. This operation should be performed in the patient's bed, and the assistant should see that the pillows are so arranged that the head will have to be moved little, or not at all, when the operation is concluded. The necessity for changing the shirt or pillow-covers is, therefore, to be avoided by protecting these with rubber sheeting.

After irrigating the conjunctival sac with warm boracic acid solution (saturated) from a sterile "undine" or small pitcher, and instilling cocain or other solutions, the eyelids, forehead and cheek should be gently cleansed with water and castile soap, by means of an absorbent cotton mop. This may be followed by an application of a weak sublimate solution, and a second boracic acid irrigation of the conjunctiva. The patient's head is now placed in proper position on the pillow, viz.: well extended and facing directly upwards. The sound eye is covered with a pad of absorbent cotton, and sterile towels are laid over the brow and scalp (this towel should be pinned to the pillow, or otherwise fastened), over the face and on the pillow.

If the eye is to be illuminated by artificial light condensed by a refracting lens, the assistant to whom this instrument is entrusted should assume a position which he can maintain, unvaryingly, throughout the operation, for if the lens be shifted at a critical moment a human eye may be sacrificed in consequence. The entire cornea, if not the entire eyeball, is to be steadily illuminated.

The preparation of the instruments has already been de-

scribed (pages 103 and 107). The operator should not be obliged to turn his eyes even for a moment from the operating field. It is important, therefore, that the instrument passer should place in his hand the proper instrument, promptly and in the exact direction in which the operator is to apply it. Similarly, after an instrument has been used, the assistant should be ready to take it promptly from



FIG. 60. Manner of passing instruments and "illuminating" for a cataract extraction.

the surgeon's hand. *The handles only* of the tools are to be touched, and the points should come in contact with nothing between the sterile basin and the eye, the eye and the basin again. If an instrument that is bloody is needed a second time, however, it may be dipped into boiled water and dried with a bit of sterilized linen, several pieces of which should be at hand.

The following is the order in which the instruments are passed: spring wire speculum ("right-sided" or "left-sided" as the case may be); fixation forceps; cataract knife;

iris forceps; iris scissors, de Wecker or other iridectome, if iridectomy is required; cystotome for dividing the lens capsule; spoon for expressing the cataract; iris repositor. (Appendix, figures 58-63.)

In addition to illuminating and instrument handing, such other assistance as *may* be needed will consist in holding the fixation forceps for a moment, and in sponging. There is usually but little blood that needs to be wiped away. The sponging is to be by pledgets of moist absorbent cotton, free of projecting fibres, and it should carefully avoid pressure on the eyeball or contact with the wound itself. If the latter requires cleansing by sponging or irrigation, this is performed by the operator himself.

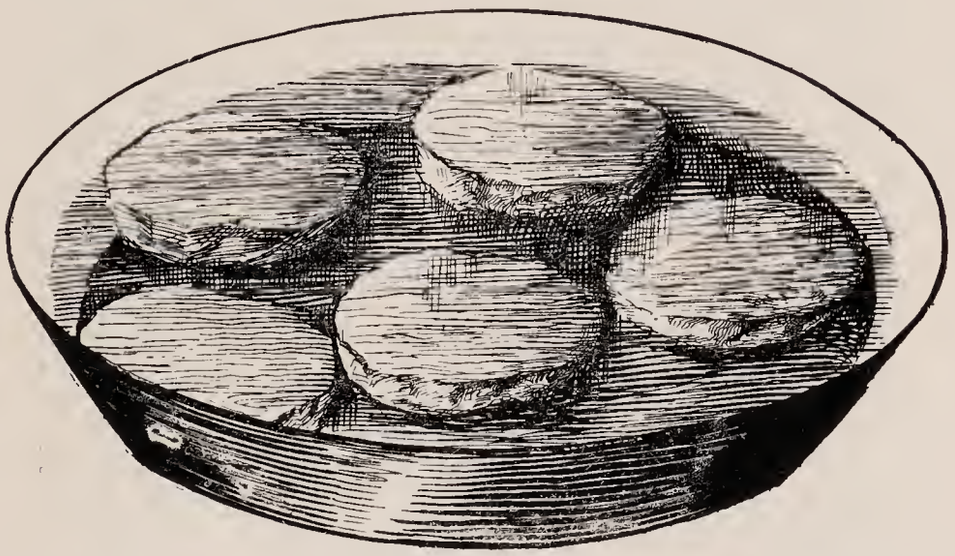


FIG. 61. Eye pads in a shallow basin of boracic acid solution.

Iridectomy requires the same assistant's technics as described above, the cystotome and spoon, however, not being needed. It is not necessary to perform this operation in the patient's bed.

Strabismus. The assistant passes the instruments in the following order: speculum, fixation forceps; conjunctiva forceps and scissors; strabismus hook; tendon scissors; tendon sutures (unless simple tenotomy is performed); conjunctival sutures. The sutures, not longer than eight inches, are usually of iron-dyed silk and mounted on small curved needles. It is best for the assistant to have half a dozen

sutures prepared in advance, for in some strabismus operations they are inserted into the tendons *before* the latter are divided.

Enucleation requires the following instruments, in order: speculum; fixation forceps; conjunctiva scissors; strabismus hook; tendon scissors, and either the same or a stronger pair of scissors to divide the optic nerve; gauze pad for pressure until the hemorrhage ceases; conjunctival suture.



FIG. 62. Dressing and bandage of one eye.

The *eye dressings* to be handed to the operator, or applied by the assistant, are ordinarily, first, one or more flat circular pads of absorbent cotton about two and a half inches in diameter (several of which pads should be prepared in advance, either dry or, preferably, kept in a shallow dish of boracic acid solution—fig. 61), over this, loose pads of dry cotton to fill in evenly the orbito-nasal hollow, and then a two-inch

roller. Beginning at the centre of the forehead, the bandage is applied, smoothly and without exerting pressure, in circular and oblique ("figure of eight") turns. If the patient wears a braid, the circular turns pass above it, the oblique turns below it, thus adding to the security of the dressing and to the comfort of the patient. After a cataract operation both eyes should be bandaged ("double figure of eight").

REMOVAL OF THE UPPER JAW.

The following are needed: scalpels, mouse-tooth and anatomical forceps, dressing forceps, straight and curved scissors, medium-sized sharp retractors, artery forceps and slender clamps, a stout probe, periosteal elevator, "keyhole" or other narrow saw, [a teaspoon bent at right angles at the junction of the bowl with the handle], mouth-gag, upper incisor dental forceps, osteotome, lion-jaw bone forceps, rongeurs, chisel, mallet, Volkmann sharp spoon, needles, needle holder, ligatures, sutures, several sponges on long handles, a few squares of gauze and several long, narrow strips of plain and of iodoformized gauze.

According to the desire of the operator, the assistant arranges the patient with the head in Rose's position, *(i. e.*, hanging, face upward, over the end of the table), or propped up almost vertically. When the latter position is adopted the surgeon may decide upon preliminary tracheotomy (or laryngotomy) and packing of the pharynx, and, in either position, if the growth be very vascular, upon placing a temporary ligature upon the carotid.

The wound assistant compresses one coronary artery of the upper lip (the operator compressing the other) while the primary incision is being made. After bleeding vessels have been secured and the cheek flap dissected up it is retracted in a piece of gauze by the assistant, who may make pressure upon it if there be much oozing. When the ala of the nose is detached there are handed to the surgeon an elevator for freeing the periosteum of the floor of the orbit, and then a "keyhole" or similar saw and an osteotome for dividing the

malar and nasal processes of the superior maxilla. During these manipulations the assistant must protect the eye from injury, and if an orbital elevator is needed for the purpose the bent teaspoon is employed.

The mouth-gag is then handed and, after that, dental forceps for extracting an upper incisor tooth. Scalpel and mouse-tooth forceps are now needed for incising and reflecting the palate, and then the saw and bone forceps again for dividing the palate process. Finally chisel and mallet and lion-jaw forceps are needed for the removal of the bone, a pair of scissors being laid within reach of the wound assistant to separate still adherent soft parts. A sharp spoon may also be called into requisition for such bone or tumor particles as do not come away with the mass. It is during the last steps of the operation that vigorous sponging out of the pharynx especially demands the assistant's attention. If the hemorrhage continue after the jaw has been removed the iodoformized gauze strips, above referred to, will be needed for packing the cavity. Silk, catgut or other sutures are handed for closing the skin wound. A light gauze dressing should be applied, to be held in place with collodion, adhesive straps or a few turns of a bandage.

CHAPTER XIII.

OPERATIONS UPON THE THROAT, NECK AND CHEST.

OPERATIONS UPON THE THROAT.

The Removal of Pharyngeal Adenoids.—Assistance at this operation consists in holding the patient much the same as for a throat examination as previously described (fig. 1), if no anesthetic is to be given; or in narcotizing, and in sponging the pharynx.

The assistant should protect himself, the patient's hair and chest, the pillow, the floor and any nearby furniture from the blood that will be coughed violently from the throat. A slop-pail should be suitably placed at the upper end of the table, or beside the bed, as the case may be. Several sponges on handles and an abundance of towels are also needed. The implements required are: mouth-gag, [tongue depressor], adenoid forceps, and curette (appendix, fig. 56), [head mirror and lamp].

It is well to repeat here that before assuming the responsibility of administering an anesthetic, the assistant should assure himself that the adenoid growths are not merely a manifestation of a status lymphaticus. Ether is to be preferred.

The narcosis should not be very deep, yet deep enough to last through an operation speedily conducted, after the mask is removed. When the patient is sufficiently "under," the mouth-gag is to be inserted and steadied by the assistant's hand. The patient's head is then brought over the end of the table (Rose's position), or to the edge of the table over which it can be turned from time to time to allow the blood to run from the mouth into the pail. The pharynx is kept clear by sponging, and a towel should be held in readiness to receive blood coming from the nose.

Retropharyngeal Abscess, incised by the buccal route. The head should hang over the table, bed or nurse's lap, in Rose's position, and the chest should be freed of clothing. The instruments to be handed are a gag, a sharp-pointed grooved director and, for opening the abscess, a narrow scalpel the blade of which is to be protected with a strip of adhesive plaster wound about it to within half an inch of the point, or a pair of sharp-pointed scissors or dressing forceps. In an infant, whose small pharynx is already largely occluded by the abscess, the introduction of a finger or of an instrument, and the escape of pus, are very apt to cause suffocation and cessation of breathing. Whatever wiping of the throat is required, therefore, should be done with small sponges and very quickly; and the assistant should be ready to perform artificial respiration. Tracheotomy is rarely required, but it is wise for the assistant to have ready a few clean instruments for its performance.

OPERATIONS UPON THE NECK.

The technic of assistance in *external esophagotomy, partial or complete thyroidectomy, removal of diseased glands or new growths in the neck, operations upon cervical bloodvessels or nerves, etc.*, follows the lines laid down in previous chapters. The patient's neck, or neck and head, should be so disposed upon a pillow that the particular site of operation is well exposed, but the anesthetist must see to it that this position is not secured at the expense of an embarrassment of the patient's respiration by distortion of the trachea. The assistant should seek to avoid injury to any nerves or bloodvessels with sharp retractors, and with doubtful structures at any rate, he should allow the operator to decide whether they are to be divided as bloodvessels or retracted as nerves. Softened, diseased glands should not be seized with mouse-tooth forceps, but with anatomical forceps or with the fingers, lest they rupture and soil the surrounding tissues. If a drop of pus escape from a gland in the course of an otherwise clean dissection, it should be wiped away with a bit of

sponge, and the neighboring structures are to be protected with gauze against further danger of contamination. As tumors or glands are being dissected out, the bloodvessels entering them should be clamped before the operator divides them. It is wise also to clamp or tie the last strand of tissue by which the growth is attached, lest it contain a bloodvessel that, retracting into the deeper tissues, may be troublesome to secure.

The dressing after an operation upon the neck should be neither uneven nor bulky. It is secured by circular turns. If the wound extends far down, however, the bandage should be applied in figure of eight turns about the neck and chest crossing posteriorly; and similarly if the wound extend upward, turns must be taken about the head.

Tracheotomy. The neck should be well extended in the median line, over a pillow. While in emergency the operation may be performed with nothing more than a pocket-knife and a hairpin or a piece of rubber tubing, when it is deliberately undertaken the assistant should prepare the following: scalpel, two mouse-tooth forceps, hemostats, medium-sized and small sharp retractors, small blunt retractor, curved and straight scissors, probe, dressing forceps, needles and needle holder, an assortment of tracheal tubes (appendix, fig. 49), and the dressing described below. The soft parts should be retracted symmetrically after the incision is made. When the thyroid isthmus is exposed it is to be drawn upward with the blunt retractor. Veins crossing the line of tracheal incision should be clamped in two places, proximally first, and divided between. After the trachea is entered the wound should be held open, with the small retractors, for the introduction of the tube. Sutures may be desired, to diminish the size of the superficial wound. A split compress of gauze is to be applied over the wound, and surrounding the canula, which latter is held in place by means of tapes tied about the neck. Over the mouth of the tube should be placed a piece of moist sea-sponge or gauze, similarly held with tape. Finally a bib made of gauze covered with oiled silk should be applied to protect the upper part of

the chest from contact with mucous discharges. Turkey feathers, trimmed to appropriate size, may be provided for cleansing the tube in situ of accumulating mucus.

OPERATIONS UPON THE CHEST.

Breast Amputation. The ordinary instruments for dissection and hemostasis are all that need to be prepared. The patient should be brought to lie with the axillary line on the affected side at or near the edge of the table. The neck, the arm, and the chest, anteriorly and posteriorly over a wide area, are to be disinfected. The upper extremity from the finger tips to the middle of the arm should be covered with sterilized towels, pinned in place or fastened with a sterile bandage, and given into the hands of a nurse who seats herself alongside the patient's head. The wound assistant should stand on the opposite side of the chest. As the dissection proceeds from place to place he should move his retractors, drawing aside the skin or lifting up the breast, as may be required. The breast must not be drawn out too forcibly, however, lest perforating branches of the internal mammary and intercostal arteries be torn off short. An abundance of artery forceps are to be kept within easy reach, and when the assistant's hands are not otherwise needed he should tie clamped vessels in order to maintain the supply of available hemostats. When the breast has been removed, *hot pads* are usually laid upon the exposed area. Before the wound is closed, the patient is to be turned slightly towards the sound side in order that a *short drainage tube* may be inserted, with dressing forceps, into an opening to be made in the post-axillary line.

The *tension sutures* usually needed vary with the tastes of different operators. While they are being tied, the flaps should be brought together with the flats of the assistant's fingers. Catgut or silk sutures (usually continuous) are then to be passed to the operator for closing the wound. To facilitate the application of the dressing the patient is drawn well out beyond the table, the head and shoulders being supported

by assistants, one of whom should hold in place the tube and gauze compress applied posteriorly. The dressing should be in the form of large pads of gauze, supplemented by flat pads of absorbent cotton over the shoulder and neck and in



Fig. 63. Application of dressing after breast operation.

the axilla. The bandages should not be narrower than four inches, nor wider than six. Several turns are first to be made about the chest, and then the arm is to be included as far as the elbow.

Empyema Thoracis. Diagnostic Aspiration. Unless the pus collection is presumed to be localized elsewhere the base

of the chest posteriorly should be disinfected. The patient is to be sat upright, as a rule, supported by an assistant's hands. Small children may be held against the chest of the assistant and facing over his left shoulder, in the manner described on page 39.

Before handing them to the surgeon, the syringe and needle should be carefully tested. If the pus is not to be immediately evacuated, the site of puncture may be covered with collodion (see page 308), or with a pledget of gauze fastened by means of adhesive plaster.

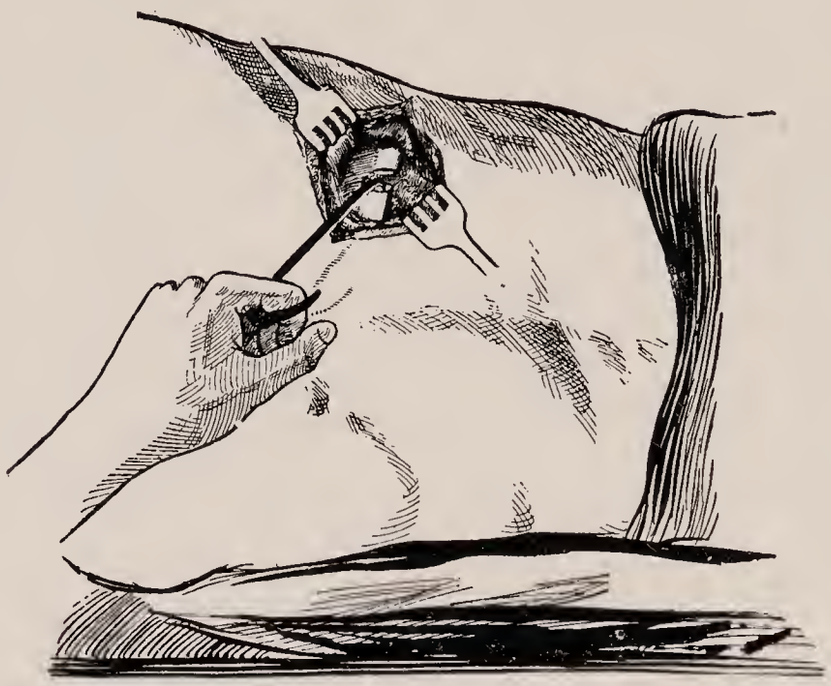


FIG. 64. Position of patient's chest in operation for empyema. Rib is drawn up with bone hook, by assistant.

Evacuation by *Simple Incision.* The patient is to be placed upon his sound side, the corresponding arm being drawn slightly forwards from beneath the trunk. If a pillow is slipped under the chest the intercostal spaces on the affected side will be the better extended. The instruments are to be passed in this order: scalpel, hemostats, ligatures, curved scissors, sharp retractors, [mouse-tooth forceps], dressing forceps, pus basin, drainage tube. As the pus is being evacuated, the anesthetist should be alert for sudden embarrassment of the respiration.

Rib Resection. The patient should be placed in the position just described. As expediency may direct, the assistant may face the patient and the operator, or stand behind the patient with the operator, but nearer than him to the head of the table. After the rib is exposed and its periosteum incised, an elevator or raspatory is handed, and then an osteotome (costotome, appendix, fig. 74). When the bone has been divided at one site the cut end of its exposed portion should be drawn up with an elevator, a bone hook or a retractor, to facilitate the second application of the osteotome. Bone hooks and retractors, thus used, must be securely applied, for if they slip they may do serious injury to the patient or the surgeons. After the bone has been removed, scalpel, dressing forceps and basin are to be handed, as in the operation by simple incision.

If two or more ribs are to be resected the assistant observes the same method of procedure. In addition he should prepare on round needles, mass ligatures for securing intercostal vessels in continuity.

CHAPTER XIV.

ABDOMINAL OPERATIONS.

The *disinfection of the field of operation and the arrangement of the towels* have already been described. As an additional precaution against infection of the wound by organisms in the skin, a saturated solution of iodoform in ether may be poured into the umbilicus and along the proposed line of incision. This solution, it may be noted, will form a blue stain (iodid of starch) wherever it is allowed to come in contact with a towel. The application of the Murphy rubber dam, or of Murphy's gutta-percha solution, more perfect means of protection against infection from the skin, needs no special description here.

ARMAMENTARIUM.

In addition to the ordinary dissecting instruments, and to the special instruments required by the individual case, there should be ready, retractors of appropriate size and shape, sponges on handles, and several gauze packings of various widths. It is well, too, to have at hand two or more clamps (appendix, figs. 44-46), intestinal sutures and, in any case where the intestines are apt to be much exposed, hot pads. In cases of doubtful nature, an aspirating syringe should also be provided.

DISSECTION OF THE ABDOMINAL WALL.

Incision through the median line.—After the superficial bloodvessels have been clamped, the assistant inserts sharp retractors in the skin wound and then, after their division, in the fascia and in the aponeurosis (linea alba). In this way the preperitoneal tissues and the peritoneum are exposed.

If the aponeurosis is divided just to one side of the linea alba, *i. c.*, through the rectus sheath, the assistant employs his retractors in a manner similar to that described below for the "trap-door" incision.

Direct incision through the muscles.—The assistant is to expose each tier of muscles (external oblique, internal oblique, transversalis), in order, inserting his retractors into the layer last divided. Vessels should be clamped as they are cut, or ligated in continuity when they are exposed before division. Nerves that can be spared should be drawn aside with the retractors.

Intermuscular dissection (McBurney).—This method is employed chiefly for the removal of an appendix in an "interval" operation. The incision through the skin and fasciæ,

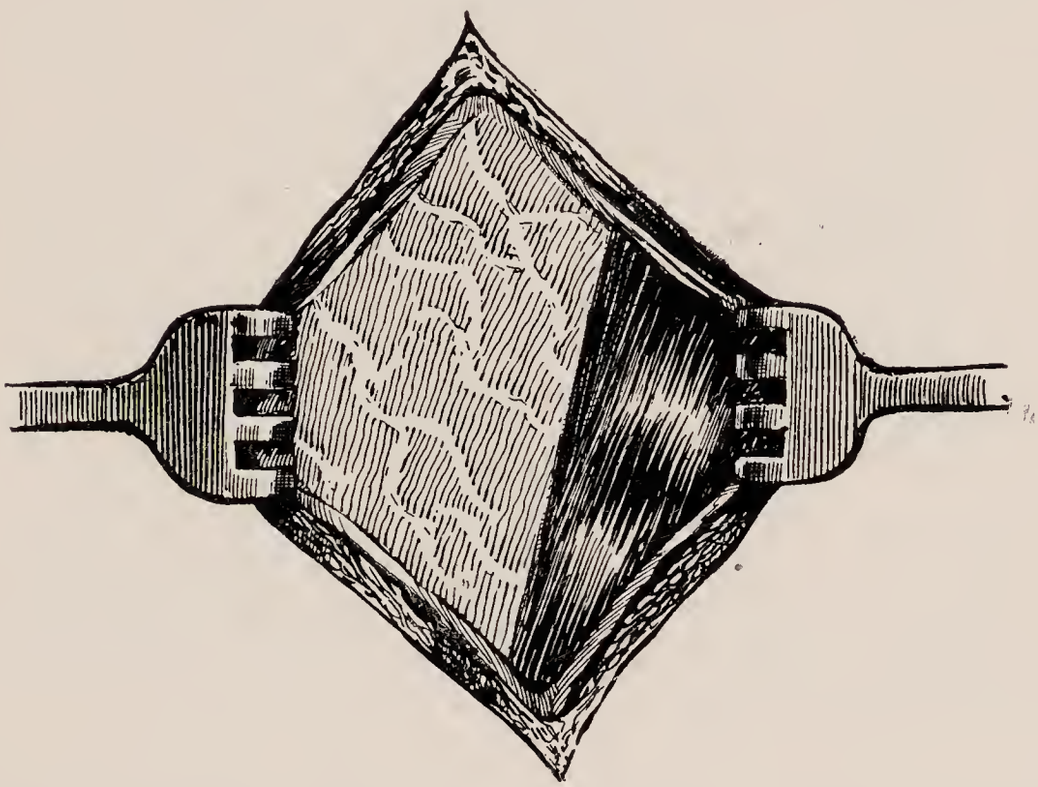


FIG. 65. "Trap-door incision." The anterior rectus sheath has been incised, and is retracted, exposing the rectus abdominis.

made parallel with the direction of the fibres of the obliquus externus, exposes, with the aid of retractors, that muscle itself. After it has been divided, by blunt dissection along the course of its fibres, the sharp retractors should be inserted

into it, in order to expose the obliquus internus. After its division, in similar manner, the retractors are shifted to this layer and placed in a position at right angles to their former direction. The transversalis, then exposed and split, is, in turn, to be drawn aside, the retractors now occupying a position parallel to the line of the body and exposing the peritoneum by a transverse slit.

The "trap-door" dissection (known also as the Kammerer incision, etc.).—The outer layer of the rectus sheath is seized by the forceps of the operator and the assistant and divided vertically,—the skin incision being usually vertical or some-

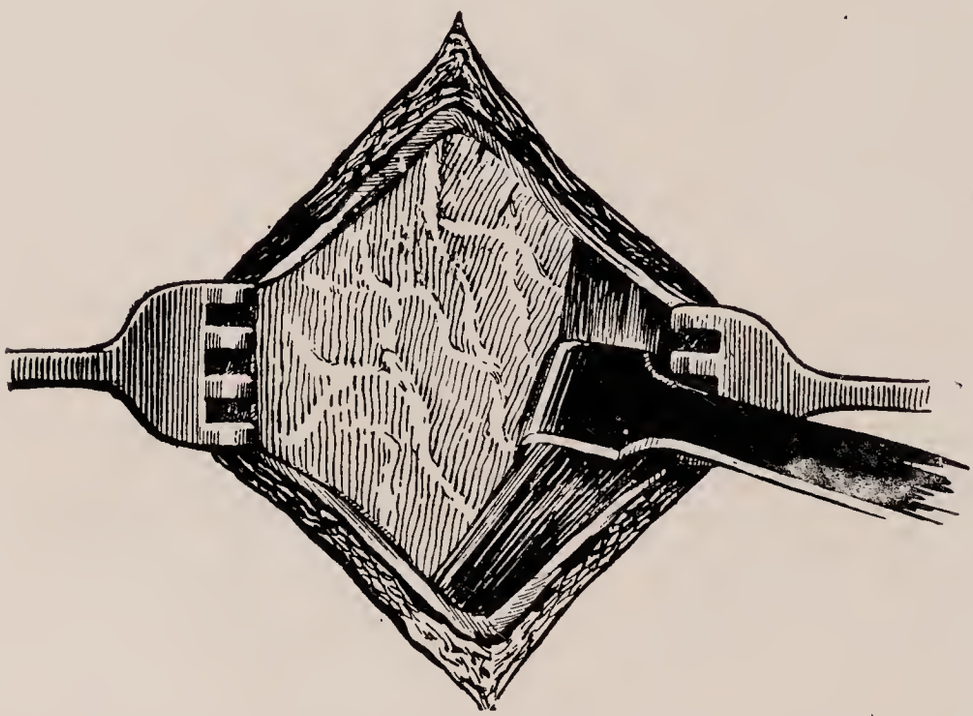


FIG. 66. "Trap-door incision." The belly of the rectus abdominis is drawn aside with a blunt retractor, exposing the posterior rectus sheath. The skin retractor on the same side of the wound is to be withdrawn.

what oblique. This aponeurosis retracted, there is exposed the belly of the rectus abdominis (figure 65) which, when freed by the surgeon, is to be drawn strongly towards the median line with a blunt retractor (figure 66), and the skin retractor on the same side is released. The assistant then picks up, opposite the grasp of the operator, the posterior layer of the rectus sheath for incision (figure 67); sharp re-

tractors are now inserted into this divided tissue, and the blunt retractor is withdrawn. The parietal peritoneum is then ready for incision.

It is very important to preserve from injury nerve fibres supplying the rectus, if they are exposed. If the incision,

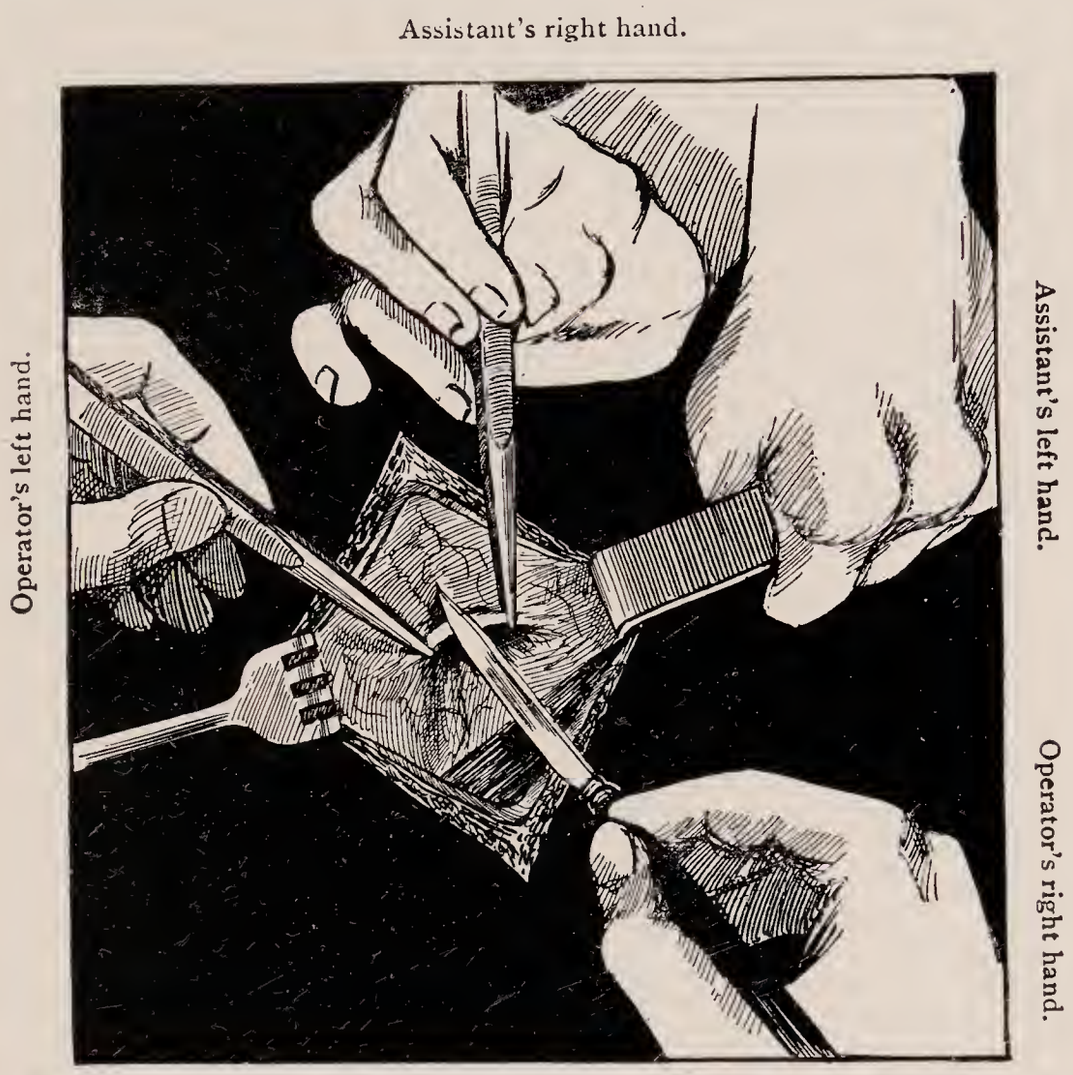


FIG. 67. "Trap-door incision." Disposition of assistant's hands for incision of posterior rectus sheath between two forceps.

as originally made or as subsequently enlarged, exposes the deep epigastric vessels beneath the rectus muscle, they should be drawn aside gently by the assistant or, if they cannot be thus spared, they are to be clamped on each side and ligated in continuity.

OPENING THE PERITONEAL CAVITY.

The parietal peritoneum, exposed by one of the above methods, is seized with tissue forceps by the assistant opposite the point grasped by the operator and lifted away from the underlying viscera. If there be much intra-abdominal tension, the belly wall itself should be lifted up with the retractors. After a small nick in the peritoneum has been made between the two forceps, with a scalpel, the assistant should continue his grasp until the surgeon has transferred his for-

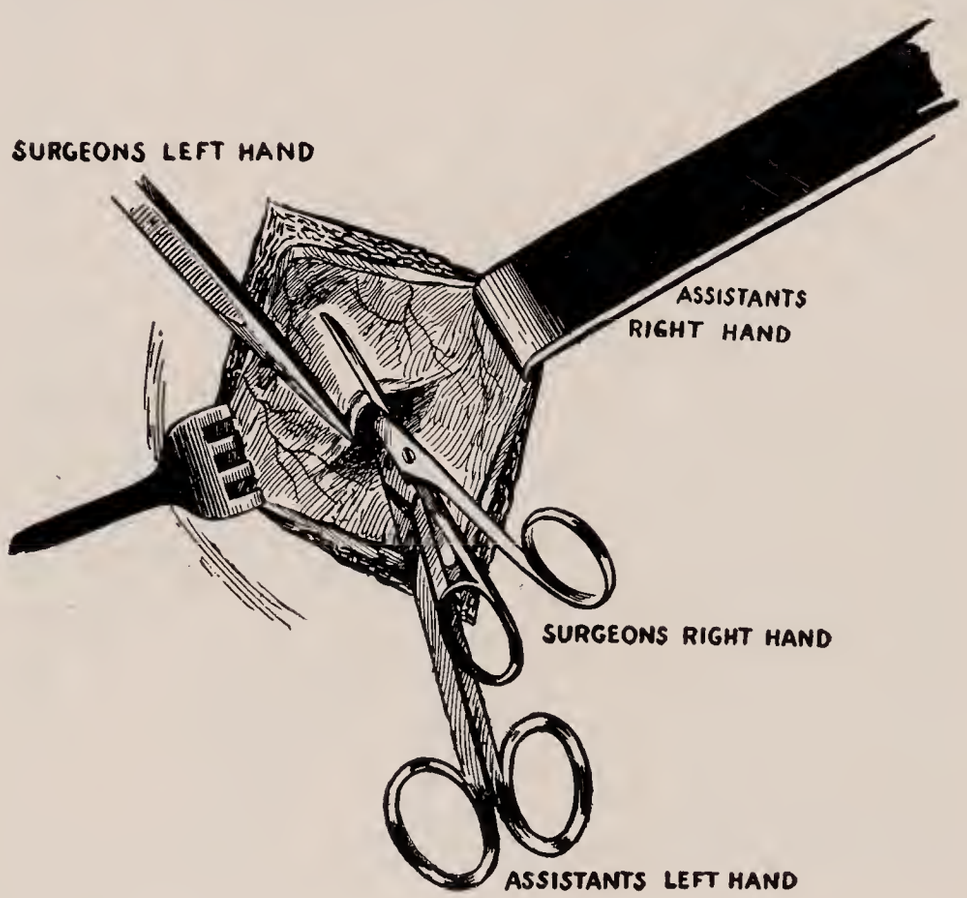


FIG. 68. Enlarging the peritoneal opening. Assistant prevents injury to underlying viscera by depressing them with blunt scissors and lifting the belly wall with retractors.

ceps to the edge of the opening. This the assistant may then also seize on the opposite side, if necessary. A pair of straight, blunt-pointed scissors with which to enlarge the opening is now handed to the operator. It may be necessary for the assistant to insert just under the peritoneum a pair of blunt scissors or a similar instrument to protect the viscera

from injury while the peritoneum is being thus further incised (figure 68). At this stage of the operation the anesthetist must make sure that the patient is well "under," lest intestine or omentum be strained through the wound. In any case a narrow packing should be ready for introduction to restrain protruding gut.

If the abdominal wall be thick, or the wound be small, the assistant may attach artery forceps or guy threads to the edges of the peritoneum, to obviate a search for them later on.

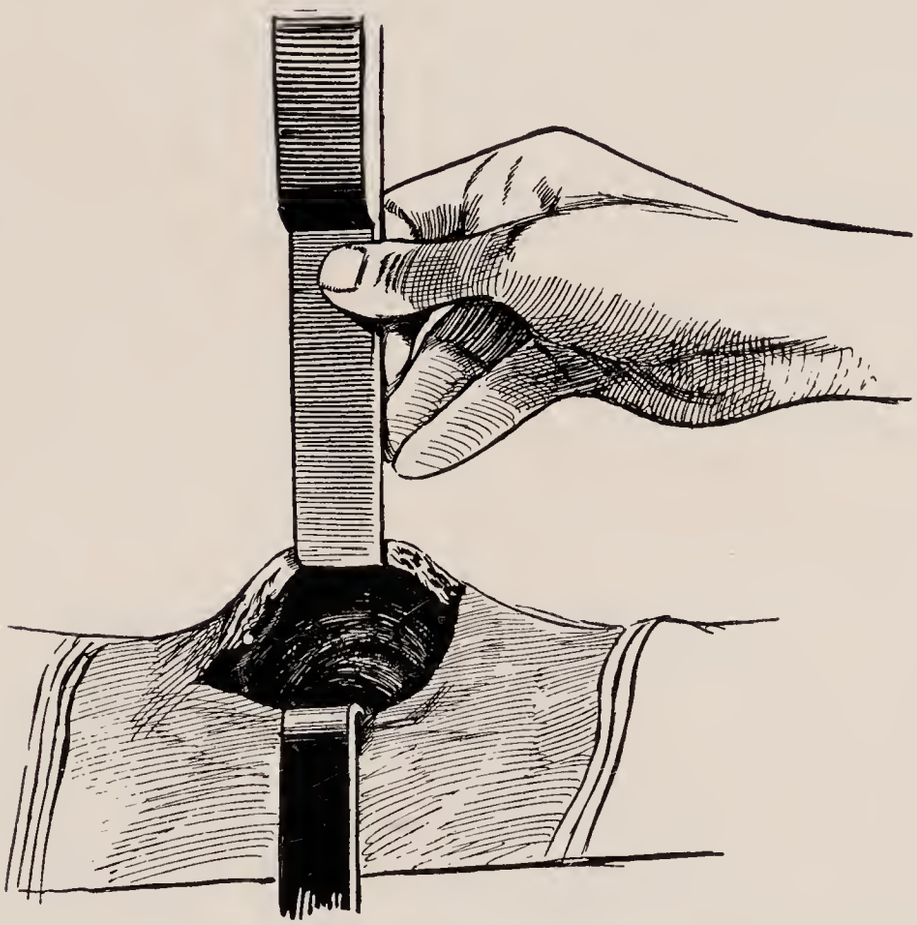


FIG. 69. Lifting up with retractors to expose to view a large visceral surface through a relatively small opening.

EXPOSING THE VISCERA.

The conditions to be dealt with and the extent and location of the wound, will indicate the necessity for retractors and the shape of instrument,—large or small, blunt or sharp,—best suited. Retractors intelligently handled may be made of

great assistance to the operator; awkwardly manipulated, they are more a hindrance than a help. Speaking generally, they should be applied symmetrically and drawn upwards. Figure 69 illustrates the use of a retractor in exposing to view a large surface through a small opening.

PADS AND PACKINGS.

The gauze packings needed during a laparotomy should be shaped by the instrument hander not only according to the size and depth of the wound, but also with reference to the purposes for which they are intended, viz.: to protect exposed viscera, to "wall off" an infected area, to restrain protruding intestine, or to serve for drainage. To cover exposed tissues the packing should be flat, and more or less broad; to surround an abscess or similar area the packings should be of four to eight thicknesses of gauze and of about the same width as the crevices into which they are to be fitted; to prevent the protrusion of intestine through the peritoneal opening, the packing should be stout and folded narrow at the end; for drainage the gauze should be folded rather narrow, as a rule. If used in the form of a wick drain, with or without the rubber tissue cover, the packing may be rolled upon its long axis, but should not be rolled very tightly. When it is to be introduced in a deep or narrow cavity, the end of the drain may be secured in a dressing forceps and handed thus to the operator. Used for drainage, the selvedge may be cut from the gauze strip, but this is not essential. Packings ought to be free of raveled edges and it is well to so prepare them that a folded edge is deepest. They should be handed vertically, with a pair of scissors curved on the flat, or a similarly shaped instrument, for introducing them. (Figure 32.) It is the assistant's responsibility that no foreign bodies be left unintentionally in the abdominal cavity. For this reason packings should be long enough to protrude well beyond the wound or, if short, they must each be seized with a clamp to be left hanging on the belly. Hot pads are likewise to be clamped; and an accurate count of

pads and flat sponges (used by some surgeons in a manner similar to packings) ought to be registered before the operation is begun and again before the wound is closed.

SUTURING THE ABDOMINAL WALL.

Through and through sutures are ordinarily of stout silk or of one or two strands of silkworm-gut, with or without buttons. They are mounted on long, heavy, curved needles. When the needle is to be thrust into the skin the edge of this tissue should be steadied with the operator's or the assistant's mouse-tooth forceps. As the needle is about to pierce the deeper layers of the belly wall the assistant with his forceps lifts their edges from their retracted position beneath the skin, one by one in order, and brings them out to the level of the skin incision. When the needle is transfixing the opposite side of the wound the assistant repeats the same maneuvers, in reverse order from peritoneum to skin. The ends of the sutures may be held with hemostats until all are in place. When the sutures are to be tied, or secured with buttons, the abdominal wall should be lifted up by means of the suture ends, in order to avoid entanglement of intestine in the strands. The knots are brought to one side of the wound. The skin edges are then adjusted, superficial sutures being handed, if necessary, to secure adaptation.

Tier sutures. Assistance should be rendered as follows in the introduction of layer sutures (alone or in addition to through and through stitches). A running catgut suture on a small needle is handed to the operator. Sharp retractors are inserted in the abdominal wall just superficial to the peritoneum, the free edges of which in the upper angle of the wound are then drawn out with mouse-tooth forceps first on the side furthest from the surgeon, then on the other side. Hooks may be introduced in the angles of the peritoneal wound to put the edges on the stretch, but this maneuver is not ordinarily required. The forceps are moved further and further down along the peritoneal layer as the suturing proceeds, the assistant holding the last stitch taut until the next stitch is introduced. (See pages 141-143.)

If protruding intestine or omentum interfere with the sewing a packing of gauze may be introduced and gradually drawn out again as the peritoneal edges are brought together. When the suture is finally being tied any pouting viscus should be pushed in with a narrow blunt instrument. The overlying muscles in the angles of the wound should then be lifted up to make sure that no gap in the peritoneum has been left unclosed; after which the suture ends are cut short.

The deepest muscular or aponeurotic layer (*e. g.*, the posterior rectus sheath) is next exposed by shifting the retractors, and its edges are grasped by the assistant's forceps (or prepared for the operator's grasp), alternately on one side and the other from above downwards, while interrupted sutures are introduced (chromicized catgut, silk, silkworm-gut, etc.) on short stout needles. These are tied at once, or "cut long" until all are in place. The next muscle layer is similarly handled. A catgut suture may be desired for the deep fascia.

If the intermuscular dissection has been made no suture may be needed to hold the split fibres in apposition, but the running catgut stitch may be continued from the peritoneum along the muscle layers, one after the other.

Assistance in the skin suturing has been described (page 143). Instead of sutures some surgeons use narrow strips of sterile (zinc oxid) adhesive plaster to secure coaptation of the skin edges.* Strips of various widths and sealed in envelopes are sold for this purpose. When they are needed the envelope should be lifted up in a towel by the assistant, and one end of it cut off with scissors. The inside sterilized envelope is then to be lifted out with forceps,—and the towel, the outer envelope and the scissors are to be laid aside as non-sterile. Before the strips are applied, the wound must be well dried and the surrounding skin, if moist or greasy, should be wiped with alcohol. The skin edges are then to be adapted while the strips, handed to the operator one by one, are laid across.

* Lilienthal's method.

THE ABDOMINAL DRESSING.

The towels are to be removed from the abdomen and the skin is to be dried. The use of dusting powders (iodoform,* aristol, etc.) or of medicated gauze over the wound is a matter rather of individual taste on the surgeon's part, than of essential technic. So, too, the operator may or may not desire next to the wound a narrow strip of sterilized rubber tissue, to obviate adhesion of the dressing or, more especially, to prevent contamination of the sutured portion of the wound by pus or feces that is expected to be discharged through a drained portion. If much discharge is to be provided for, loose pieces of gauze are first laid on, either dry or as a wet dressing covered with rubber tissue. Otherwise, a small flat piece of gauze is applied to the wound. A large square of gauze covers the deeper dressing, and is to be held in place by ordinary adhesive, or by "laparotomy" straps.

Laparotomy straps are made of strips of adhesive plaster about two inches wide and eight to ten inches long. One side is folded upon itself for a distance of an inch and through the double thickness here a hole is cut into which an end of a piece of tape twelve inches long is tied. A piece of "face cloth," a little longer than the adhesive strap (so that it can be easily stripped from it), is kept over it until the strap is wanted. Two or more of these straps, according to the size of the dressing, are applied symmetrically to the patient's flanks, and their corresponding tapes are tied tightly over the dressing. A double turn of the tape, as in the surgeon's knot, secures it from slipping while the second (bow) knot is being made (figure 70).

In lieu of laparotomy straps long strips of adhesive plaster may be passed from one side of the abdomen to the other across the dressing. They are to be drawn tightly from the side to which the first end is attached, and before the other

* Iodoform crystals are less apt to "cake" and occlude the orifices of the powder sifter than is powdered iodoform.

end is fastened down the skin here should be pushed up by the flat of the hand. This relieves the wound of much tension. The same thing may be accomplished, perhaps a little more quickly, by applying two straps at a time, one from each side of the abdomen at different levels, and drawing tightly

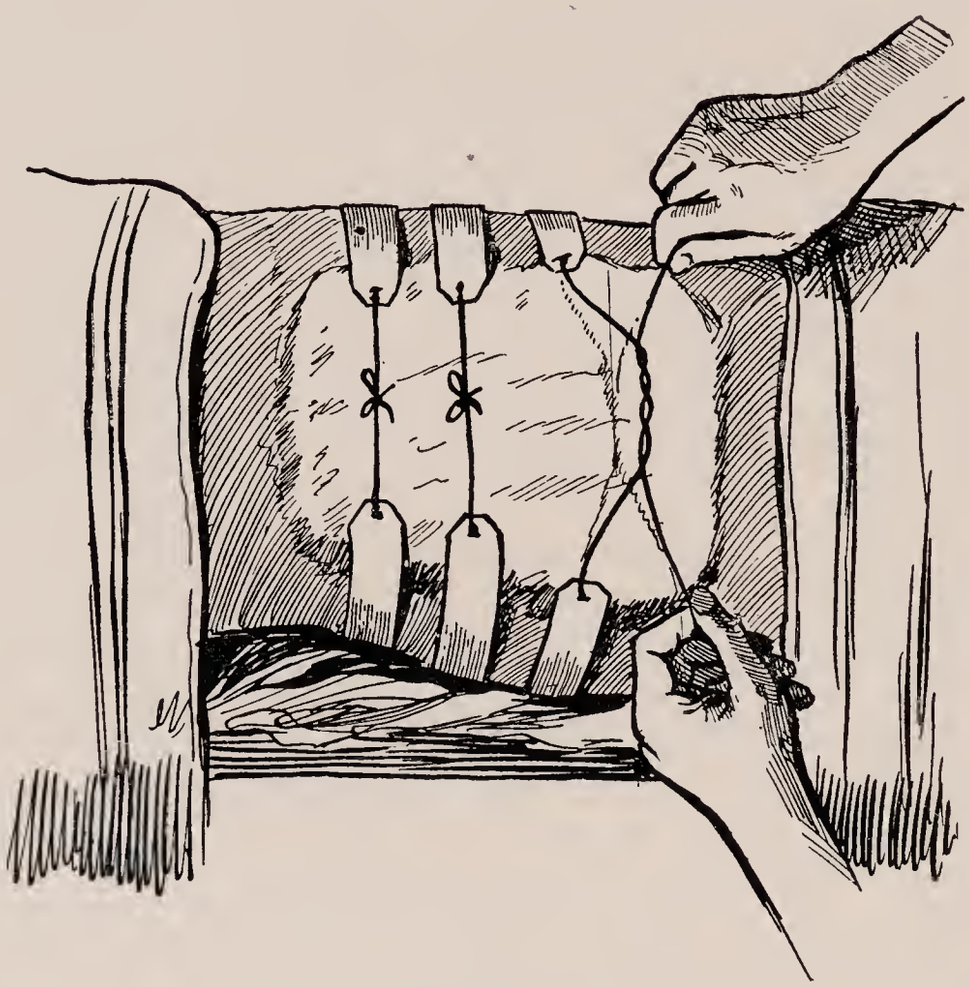


FIG. 70. Tying laparotomy straps.

upon each as they are simultaneously crossed over the abdomen and fastened down (figure 71).

Over the straps large flat pieces of gauze are to be placed, and over these a sheet of absorbent cotton. The entire dressing may be secured by means of a bandage or, better, with a binder. The binder is to be rolled up half across its width and the rolled edge slipped under the patient. While the body is raised to accomplish this, the back should be quickly dried with a towel and the underlying wet sheets withdrawn. The ends of the binder are then overlapped in front and

fastened tightly in the median line with a row of safety pins. For slim subjects a towel may be thus used as a binder. The Scultetus, or " many-tailed," binder is to be similarly applied,

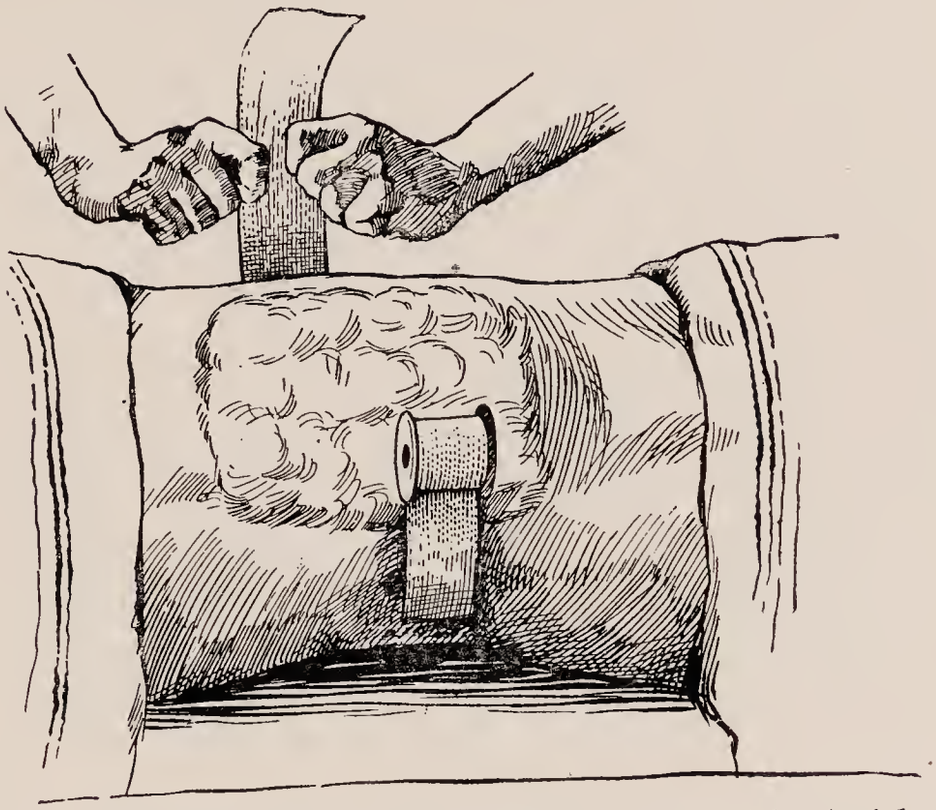


FIG. 71. A method of applying adhesive straps over the abdominal dressing.

the tails being overlapped from each side alternately, the last crossing (or, if need be, several crossings) being secured with safety pins.

CHAPTER XV.

ABDOMINAL OPERATIONS.—Continued.

EXPLORATORY LAPAROTOMY.

The assistant must consider each of the conditions that the lesion may prove to be and prepare for all of them. Thus a doubtful tumor may be a mass of adhesions, an abscess, a cyst, a new growth requiring resection of the intestine, etc. For exploratory laparotomies after gunshot and crushing injuries he should prepare hot saline solution, hot pads, intestinal sutures, clamps and ligatures for the removal of a ruptured viscus, etc.

APPENDICITIS.

"Interval Operation." Removal of the Appendix and Cauterization of the Stump. The wound is to be well retracted and packings should be inserted, if necessary, to restrain protruding intestine, while the operator searches for the cecum and appendix with his fingers or with anatomical forceps. The appendix found and drawn well out of the wound, the assistant may remove his retractors. There is then handed to the operator a double strand of (number two) catgut mounted in a ligature carrier or pair of forceps. When this has been thrust between the appendix and its mesentery the assistant seizes it, cuts it in two and separates the ends. He is then to take the appendix from the hand of the operator and hold it on the stretch, so that one of the ligatures can be tied about the entire mesentery of the appendix close to the base. [Two or more ("chain") ligatures may be called for if this tissue is very broad.]

The mesentery thus secured, a pair of scissors is passed for amputating it. After the appendix has been tied with the other ligature, the assistant places a split compress about the base of it, and hands a small clamp (artery forceps) with which to secure the appendix just beyond the proposed line of amputation. This forceps and the appendix itself the assistant holds while the surgeon, drawing upon the appendix ligature, ablates the organ. The appendix, the attached forceps, and the scissors are at once dropped into a specimen dish or towel and *discarded* as "soiled." If the Paquelin

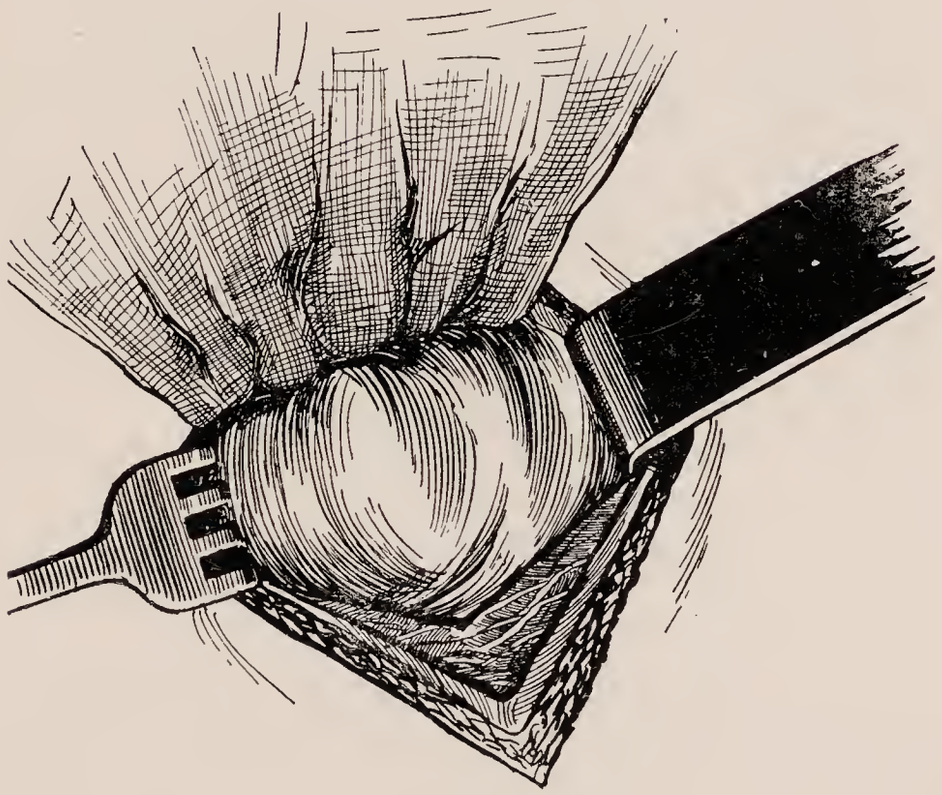


FIG. 72. Gauze packing inserted and cecum drawn into the wound.

cautery is to be used to disinfect the stump, there should be handed to the operator a sterile towel in which to receive the handle of the instrument. Pure carbolic acid may be used with equal effect and greater convenience,—the tip of a probe or closed dressing forceps is dipped into the phenol and excess of the fluid is allowed to drip off. The appendix thus treated, the split compress is to be removed and the ligature ends ablated.

Removal of the Appendix and Inversion of the Stump. Here the assistant hands only a single ligature for the mesentery. Then he provides a fine catgut or silk suture in a small needle to be passed, purse-string fashion, about the base of the appendix. Split compress, clamp and scissors are then needed as in the other method; and soiled instruments are afterwards removed in the same manner, with the appendix. A probe is next handed to test the patency of the lumen

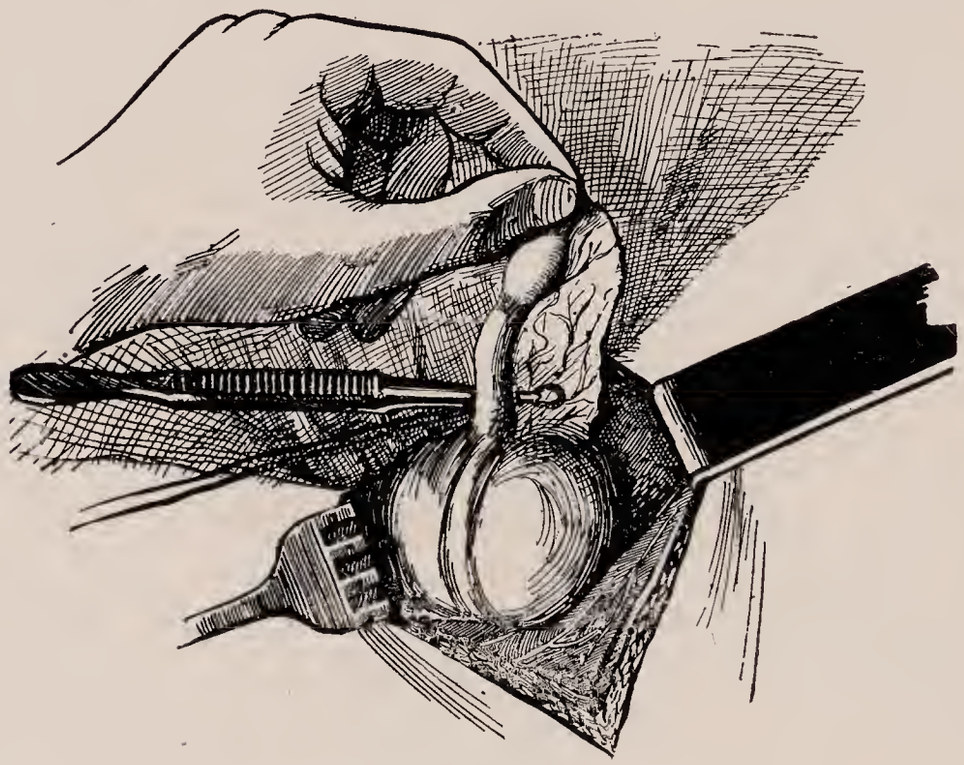


FIG. 73. Assistant lifting up appendix while the operator inserts double ligature.

of the appendix stump. The probe is then *discarded.* The assistant now thrusts in the mucous membrane of the stump with mouse-tooth forceps while the surgeon ties the purse-string suture; after which the forceps thus used are *discarded.* The split compress is removed and a fine silk suture is handed for sewing over the stump (Lembert suture).

Appendicitis with Abscess. The scrubbing of the abdomen should be performed gently. The assistant prepares in advance several packings, of various widths, and a generous supply of bits of sea-sponge. These bits may be mounted on

hemostats or left in a dish from which they are to be lifted, as needed, with thumb forceps. The location of the abscess determines the site of incision and the method of dissection, and the assistant will follow the movements of the operator, in these cases, rather than proceed along any very exact line of technics. Packings will probably be required until the abscess is reached and again after it is opened, to protect the surrounding tissues. The sponges must be in readiness for the first sign of pus and the assistant should manipulate them quickly, but with care not to scatter infectious material with

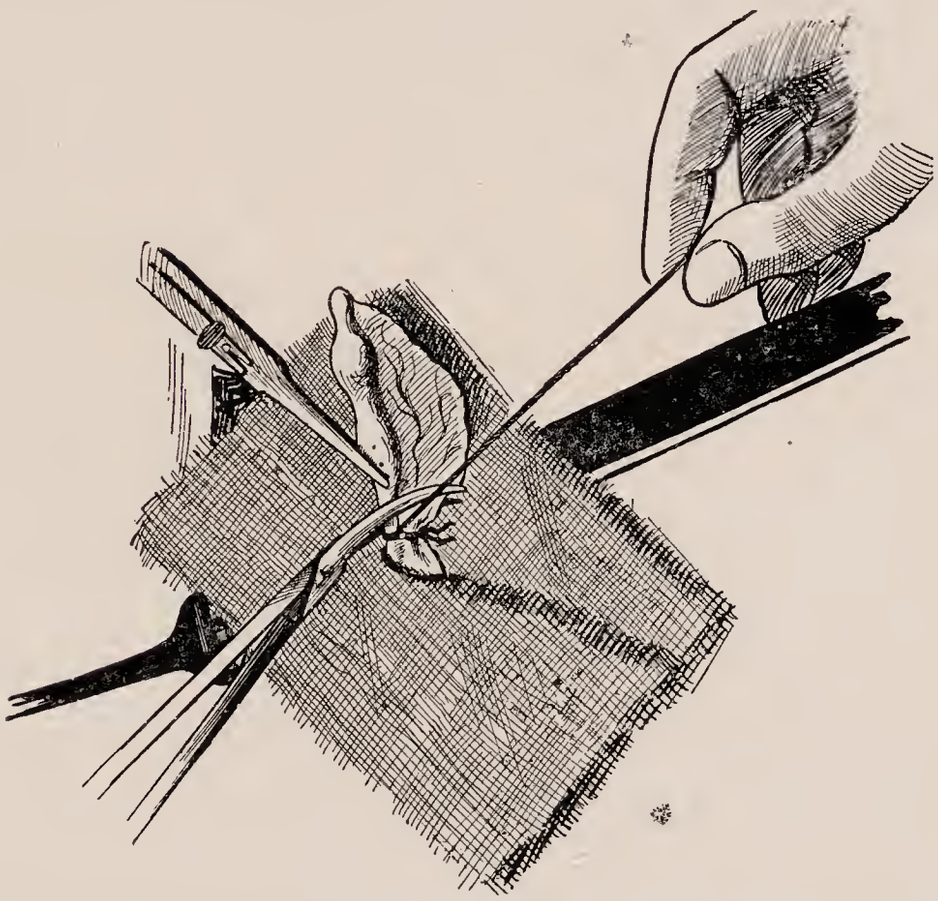


FIG. 74. Amputation of appendix. Ligatures, clamp and split compress in place.

them. If the appendix is to be removed the assistant follows the technics described above—modified, however, according to the condition of the organ. Cauterization of the stump is not required. While the operator may require gauze alone for drainage it is well to have a drainage tube in readiness, also.

GENERAL PERITONITIS.

From Appendicitis or Other Cause. The duties required of the assistant are much the same as in abscess operations. The use of irrigating solutions, drainage methods, etc., is a matter of individual technics. Deep collections of pus require removal by sponges on long handles. If the operator decides upon opening one or more coils of distended intestine, the assistant surrounds the selected portion of gut, drawn well out of the abdomen, with hot towels. A scalpel, trocar or aspirating needle is handed for puncturing the intestine, and a pus basin is held beneath. A silk suture will be needed to close the opening. As a matter of surgical cleanliness the assistant should rinse his hands after this procedure, and spread fresh towels about the wound.

Lavage of the Stomach before the operation may be required of the assistant when there has been a great deal of vomiting. If this is done while the patient is anesthetized a gag should be introduced into the mouth. A rubber tube about thirty inches long is connected at one end to a large (preferably glass) funnel, and at the other end, by means of a glass canula, to the stomach tube. The latter is to be dipped in water and then passed to the posterior wall of the patient's pharynx and guided into the esophagus. Many tubes are marked to indicate the proper length to be inserted (about fourteen inches), and often regurgitation through the tube will indicate that the stomach has been reached. If efforts at vomiting are induced by the introduction of the tube the funnel should be held down over the edge of a slop pail on the floor to allow drainage of the stomach contents through the tube. The funnel is then to be filled and held above the level of the patient's head. Before it is entirely empty it is filled again, and this is repeated until about a quart of warm water or warm saline solution is poured into the stomach. Before all the water has left the funnel the latter is depressed into the slop pail, thus siphoning out the material in the stomach. This procedure is to be

repeated until the water returns clear. If necessary, intermittent manual pressure over the stomach may be employed to help in emptying it. As in gavage, the tube may be introduced through the nose when, for any reason, the mouth is ineligible.

CHAPTER XVI.

ABDOMINAL OPERATIONS.—Continued.

OPERATIONS UPON THE GALL-BLADDER AND GALL DUCTS.

Cholecystostomy, Cholecystotomy. Long stout probes and sounds, stone spoons and forceps, clamps and ligatures for adhesions, an aspirating syringe, sponges on handles, a pus basin, drainage tubes and gauze packings, should be in readiness, and in a case of empyema of the gall-bladder irrigating solution should also be at hand. The assistant will aid in exposing the gall-bladder by the use of retractors placed in the abdominal wall and, if necessary, a large one under the edge of the liver. Stout catgut ligatures are handed for tying adhesions, and torn adhesions should be covered by the assistant's sponges to prevent oozing of blood into the abdominal cavity; packings will be needed for covering exposed intestine and for surrounding the gall-bladder. For cholecystostomy a running catgut suture on a small, round, full-curved needle will be required for attaching the gall-bladder to the parietal peritoneum. If the abdominal wall is thick the surgeon will probably desire first, however, a few interrupted catgut sutures to fasten the parietal peritoneum to the subcutaneous tissues. The gall-bladder thus fastened, a narrow strip of gauze is handed for further closing off the abdominal cavity at the circumference of the exposed area of the fundus of the gall-bladder. If the operation is to be conducted in two sittings the assistant now hands a loose gauze pad for covering the wound, and the usual outer dressings. If the operation is to be concluded at once, however, the assistant will act next according as to whether the gall-bladder contains chiefly stones and very little fluid or is distended with fluid (hydrops, empyema).

In the first case he will hand scalpel and mouse-tooth forceps for opening the viscus, forceps and spoons for removing stones, sound for probing the ducts, tube for drainage, [catgut gall-bladder suture], and dressing. In the second case an aspirating syringe having first been handed for determining the contents of the bladder, the assistant turns the patient so that he lies on his right side near the edge of the table, covering meanwhile with a sponge or pledget of gauze the needle hole in the bladder. A "bib" of sterilized rub-



FIG. 75. Assistant holding patient on his side while contents of gall-bladder flow into pus basin.

ber tissue is then placed over the lower portion of the wound and tucked into its angles, to prevent soiling of the tissues. A pus basin being held in position, scalpel and dressing forceps are passed to open the gall-bladder. One or two drainage tubes will next be needed through which to irrigate the viscus, and after these stone forceps and sounds.

When cholecystotomy is performed sutures of catgut, to close the mucous membrane, and of silk for the peritoneal covering of the gall-bladder, are to be ready.

Choledochotomy. Retractors, wide and narrow gauze packings, and ligatures for adhesions will be needed much as for cholecystostomy. If the common duct is being attacked there should be handed two guy sutures to secure it on each side of the proposed line of incision; then scalpel and narrow-bladed stone forceps; then another suture of plain or chromic catgut, on a small hemostatic needle in a slender holder, if the duct is to be sewed; then a drain of gauze, or of rubber tubing to be surrounded by narrow gauze packings. For the partial closing of the wound "through and through" sutures of silk or silkworm-gut will probably be all that are demanded. It is important during an operation upon the common bile duct that the anesthetist keep the patient well "under," and yet, because of the great shock of the operation, that he administer no more of the anesthetic than is really necessary.

Cholecystectomy. The gall-bladder and cystic duct must be well exposed by retracting. As the bladder is being stripped from the liver and from surrounding adhesions by means of blunt, curved scissors the bleeding surfaces must be sponged, actively but gently. The stripping process completed, a stout catgut ligature is to be handed for the cystic duct. This ligature the assistant will probably be called upon to tie (while the operator holds it in the position he desires and lifts up the bladder). All surrounding tissues being now protected with gauze, a right-angled, curved clamp ("gall-bladder clamp") is handed, to secure the neck of the viscus, which is then amputated with scissors, the assistant drawing gently on the duct ligature. Scissors and gall-bladder are received in a specimen dish, and there is handed a Paquelin cautery, or an instrument dipped in pure carbolic acid, with which to treat the stump. A cigarette drain of length sufficient to reach the stump will be required next. The temporary packings removed, sutures are handed for closing the wound.

OPERATIONS UPON THE LIVER.

Cyst of the Liver; Abscess of the Liver, opened anteriorly.

The liver exposed, an aspirating syringe with a long stout needle will be required to explore it. If fluid of a doubtful character is drawn into the syringe there should be handed a white dish into which the material may be thrown for closer scrutiny, the assistant meanwhile holding his finger over the end of the needle projecting from the liver. When the abscess or cyst has been located the surgeon may decide to empty it at a later occasion or to finish the operation at once. In the first case sutures or gauze packings, or both, are needed to close off the abdominal cavity, as in operations for empyema of the gall-bladder; a ring of gauze is placed about the needle to support it in position; and a light dressing is applied. In the second case, after packings are inserted all about the exposed liver surface, alone or in addition to a line of sutures, a long dressing forceps is to be handed with which to open the cavity along the path of the needle. The needle is removed and there are provided one or two large drainage tubes, through which the operator may wish to irrigate. A split compress and an abundant dressing of loose gauze should be applied.

Cyst of the Liver; Abscess of the Liver; Sub-phrenic Abscess, opened posteriorly.

The patient is placed on his left side. Instruments are passed the same as in rib resection for empyema thoracis *(q. v.)*. If during the dissection, the pleural cavity be invaded the assistant should at once place a finger over the opening until a suture, which should be ready for such an inadvertence, can be inserted and the suture line covered with a plug of gauze. Mouse-tooth forceps and scalpel are needed for incising the diaphragm. The remaining steps of the operation the assistant provides for as described for the anterior route.

Resection of the Liver (New growth). The chief duties of the assistant here lie in exposing and sponging the field,

in properly protecting surrounding viscera, and in providing for hemostasis. For the latter there will be needed slender clamps, the Paquelin cautery, ligatures, hemostatic sutures in round, half-curved needles, and several narrow packings. In addition to these articles, and to the usual preparations for laparotomy there should be ready instruments for rib resection (page 183), pedicle ligatures, aspirating syringe and sutures to attach the liver to the margin of the abdominal wound.

CHAPTER XVII.

ABDOMINAL OPERATIONS.—Continued.

OPERATIONS UPON THE STOMACH AND INTESTINES.

GASTROSTOMY.

If practicable the stomach should be washed out before the operation (page 200).

The assistant stands on the left side of the patient's abdomen, relaxation of which is increased, if need be, by elevation of the knees and shoulders. The abdominal wall having been divided, by vertical or oblique incision, the assistant inserts retractors to facilitate the search for the stomach. A retractor may be required to elevate the overlapping area of the liver. The stomach brought up into the wound, packings will be needed to surround the portion in which the opening is to be made. In addition an assistant's hand, gloved or covered with gauze, will probably be needed to hold the anterior surface of the stomach in proper position.

The Witzel Method. Forceps and scissors are handed, with which to make a small opening near the cardiac end of the stomach. Into this is to be snugly fitted one end of a piece of red rubber tubing six or eight inches long and of about the diameter of a stomach tube, which the assistant now provides. Next will be needed several fine silk sutures with which to sew together over the tube the folds of the organ on each side of it. While these stitches are being introduced and tied, the assistant holds the tube in the opening and flat against the stomach. After that he hands a running catgut suture to unite the parietal peritoneum on each side of the wound to the visceral peritoneum about the tube. A clip is then to be placed on the free end of the drain, and loose gauze applied around it, to be held in place with adhesive straps and a bandage.

The Marwedel Method. A suture having been handed to fasten the stomach to the free edges of the parietal peritoneum, scissors or scalpel are needed for incising the serous and muscular coats. Then a narrow, blunt, periosteal elevator or similar instrument will be required to strip the mucous membrane from the superficial coats for a short distance beyond the opening. The tube will then be slipped into this canal, and a suture is needed to hold it. Instead of this the operator may incise the outer coats and separate them by direct dissection, sewing them together again over the tube.

The Kader Method. A running suture is to be handed for attaching the stomach to the abdominal wall. A tube is needed, as in the other method, to be held vertical after being inserted in its opening, while concentric running sutures of silk are stitched about it and drawn tight.

Albert and Ssabanijews-Franck Methods. The assistant holds a large cone of the anterior wall of the stomach projecting through the wound, while the operator attaches the base of the cone to the parietal peritoneum and posterior rectus sheath. A scalpel is then to be handed for making a second skin incision and for dissecting up the skin between this point and the larger wound. Forceps are passed to draw the apex of the cone through this subcutaneous channel, and then scissors and a few stitches to open this apex and fasten it in place. Sutures are next required to close the large wound.

Internal Esophagotomy, after gastrotomy or gastrostomy. For this there are to be prepared, in addition to the usual instruments, a pair of long slender dressing forceps, an assortment of fine and stouter esophageal bougies, several long strands of silk of various thicknesses [and a mouth-gag].

GASTRORRHAPHY AFTER PERFORATION OF THE STOMACH. ENTERORRHAPHY AFTER PERFORATION OF THE INTESTINE.

There should be at hand several gauze packings and hot pads, sponges on handles for mopping out infectious material, hot salt solution for irrigation, drainage tubes, and

several fine silk sutures. The wound should be well retracted while a search is being made for the perforation. When this is found, the assistant must be ready with a small sponge to check the escape of fluids, and with packings to wall off the area to be treated. The immediate neighborhood of the perforation having been cleansed, and the affected portion of the viscus being steadied in the wound, the silk sutures are next required. When the perforation has been satisfactorily closed over, sponges will be needed to wipe out infected pockets among the intestinal coils, which are to be exposed systematically, one after the other. The conditions present will demonstrate the need or otherwise for irrigation and the provisions to be made for drainage.

GASTRO-ENTEROSTOMY; GASTRECTOMY; PYLOROPLASTY; PYLORECTOMY.

The assistant's preparations for, and technics in, these operations are, for the most part, the same as for intestinal anastomosis and resection *(q. v.)*; and, for the rest, his manipulations, *e. g.*, the holding and exposing of the stomach and the gut, etc., are indicated to him by the operator's methods. Plastic operations require that several medium-fine silk sutures be prepared in advance, with straight (cambric) or with small, full-curved needles, or with both. Clamps similar to, but longer than, those used for the intestine, are employed upon the stomach in resecting that viscus.

COLOSTOMY.

Inguinal Colostomy. The division of the abdominal wall completed, bleeding vessels ligated, and the intra-abdominal conditions surveyed, the assistant draws out the free margins of the parietal peritoneum for the surgeon to secure this tissue to the skin edge of the wound with a running catgut suture. While this is being done, a gauze compress may be needed to prevent bulging of the intestine through the wound. The desired portion of the colon having been delivered into the opening, packings may again be needed, both to support this gut temporarily and to restrain other coils.

To ensure the presence of an ample "spur," a glass rod, metal sound or similar instrument may next be required. The assistant with both hands draws the segment of colon well out of the abdomen, while the operator thrusts the rod through the meso-colon close to its junction with the intestine. Interrupted silk sutures are now to be handed to the surgeon for fastening the circumference of the presenting portion of colon and the meso-colon to the everted margin of the parietal peritoneum, the assistant gently drawing

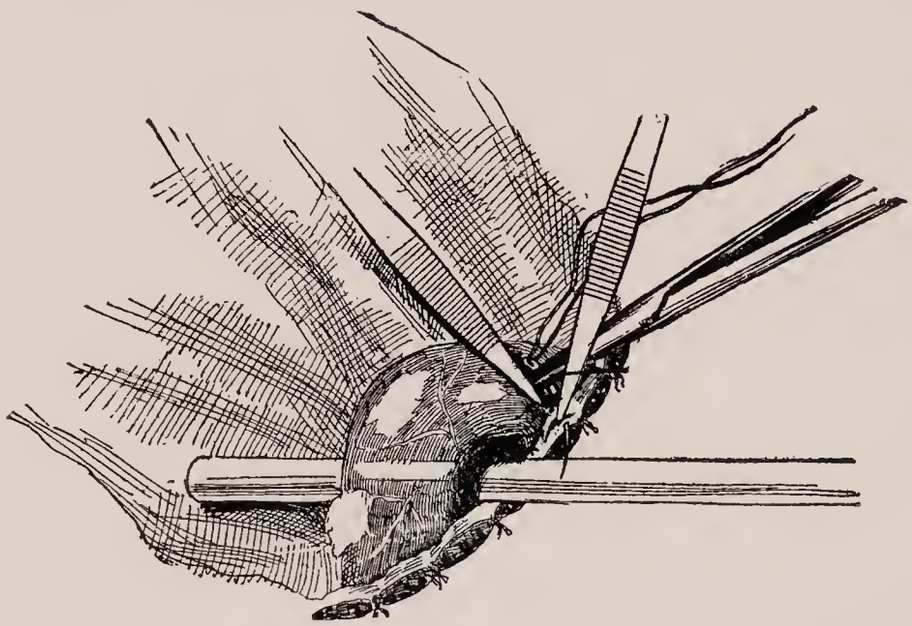


FIG. 76. Inguinal Colostomy. Rod in place. Manipulation for anchorage of visceral to parietal peritoneum.

first one portion of the gut and then another upwards and towards the center of the wound as the stitches are put in place and cut short.

If the intestine is to be opened at once a gauze strip should be tucked about its base. The patient is then turned upon his side, and a pus basin held in place to receive the fecal discharge. Forceps, and scissors or scalpel are handed to the operator and after these, if needed, a long drainage tube. Irrigation of the colon, by means of a piston- or fountain-syringe, may be desired. The parts are then to be cleansed and the skin about the wound is to be freely anointed with vaselin. The dressing consists of a ring of gauze surrounding the wound, and abundant loose gauze above it.

If the intestine is not opened at once, a good-sized tea-strainer may be inverted over it, the metal rim resting on a ring of gauze—to prevent pressure upon the gut by the superimposed layers of gauze.

Lumbar Colostomy. The patient is placed on his side—usually on the right side—with a cylindrical cushion under the lower loin. Instruments are passed for dividing and retracting the skin and muscles. Ligatures should be handed for tying all the clamped vessels before the colon is sought for. After the perinephric fat has been torn through it is to be retracted by the assistant. If the kidney obstructs the route to the gut, the assistant should hold it aside with his fingers. The (posterior surface of the) colon delivered into the wound, stout sutures of [chromicized] catgut are next needed for anchoring it to the skin. If the meso-colon is sufficiently long, a rod may be desired to support the colon, as described above, before the sutures are introduced.

The opening and drainage of the gut, and the dressing of the wound, are as in inguinal colostomy.

INTESTINAL RESECTION.

Hot pads and salt solution, sponges on handles and a variety of gauze packings, should be at hand. Several silk sutures on fine curved and straight cambric needles are to be prepared, and a supply of catgut ligatures should also be cut in advance. In addition to the usual instruments for dissecting, a few straight clamps should be provided and either intestinal clamps or two strips of gauze or of rubber tubing. Murphy buttons or similar devices may be used by the operator, and should be made ready, if provided.

When possible, the segment of gut to be resected is usually drawn outside of the abdomen and surrounded by hot towels. Before this can be accomplished it may be necessary to supply clamps and ligatures to separate adhesions. The assistant lifts up several inches of the intestine on the proximal side of the area to be excised, while the operator "milks" its contents out of it and thrusts through the

mesentery, five or six inches from the line of division, an intestinal clamp or strip of gauze and secures the intestine in this. The distal segment is then similarly lifted up, emptied and secured. Instead of by gauze or clamps, the escape of feces may be prevented by digital compression of the intestine if an assistant can be spared for this purpose. The mesentery is then to be spread out, and mounted ligatures handed to secure its vessels. After the mesenteric wedge has been cut away with scissors, large gauze compresses are to be placed under the intestine. Two clamps will then probably be desired for application, one at each line of section. As the gut is cut through on each side, the assistant should so manage the open ends that all the escaping contents fall upon the gauze. The resected tissue is received in a basin and removed. With thumb forceps the assistant lifts up and holds open first one and then the other segment of intestine while the surgeon wipes it out with sponges on handles, which are, of course, to be at once discarded.

The soiled gauze having been removed, the assistant now rinses his hands and spreads fresh compresses in preparation for

INTESTINAL ANASTOMOSIS.

(1) By *Circular Enterorrhaphy.* Six to eight "anchorage sutures" of medium-sized silk on straight (cambric) needles are first needed. With mouse-tooth forceps the assistant picks up the edge of the open end of each section of gut at its mesenteric side in such a manner that the mucous membrane is everted. This facilitates the introduction of the sutures from within outwards, their knots falling within the lumen of the gut. The first stitch may be left long, clamped and held taut, the assistant transferring his forceps to the points on the circumferences of the mouths of the gut segments opposite to the mesentery, where the second anchor suture is passed. Accurately corresponding points on the sides are lifted up in turn, everted and coapted. The edges of intestine are to be turned in again as the sutures are tied and cut short.

This method of introducing the deep sutures is modified by various operators. Thus the assistant may provide two anchorage sutures—for the mesenteric edge and the point opposite—to be left long and held taut, while a continuous through and through suture is passed about the entire circumference, from within outward from the mesenteric to the free border, and from without inward back to the mesentery, where it is tied and cut short. The two guy sutures are then tied while the edges of the gut are being pushed in by the assistant.

The second layer of stitches (Lembert sutures) are of fine silk on small straight or curved needles. To prevent snarling, each thread should be of moderate length—not longer than for two sutures, and the assistant must keep the strands separated as they are introduced. As they are being tied, usually in batches of five or six, the serous surfaces are to be gently adapted with forceps. These sutures are to be cut short. The intestinal clamps or gauze constrictors are then withdrawn. After the surgeon has satisfied himself that the intestine is everywhere properly closed, the assistant lightly sponges off the parts, again removes the underlying soiled gauze and, cleansing his hands, places fresh towels under the intestine, which is now spread out to expose the mesentery. Continuous or interrupted sutures of No. 2 catgut on half curved needles are handed for the coaptation of the cut mesenteric edges, the assistant keeping the tissue spread out lest no portion, curled up, be left unsewed. During all these manipulations, if the intestines are much exposed, hot towels should be replaced as soon as they cool. The enterorrhaphy completed, the pads and towels are removed and the abdominal walls lifted up so that the gut may be dropped into place, the assistant (and nurse) making sure that no sponge or compress is left within the abdominal cavity.

(2) *By Maunsell's Operation.* The bowel segments are held end to end while the operator inserts a long temporary suture through all the coats of each at the mesenteric border, and another at the points directly opposite. The needles are left attached to these sutures. The assistant then holds the

convex border of the proximal segment near the end while the surgeon makes a slit in its long axis with scalpel and scissors, bleeding points being compressed with hemostats. When he then passes the two temporary sutures into the lumen of this segment and out through the slit, the assistant aids, by gentle manipulation, in effecting the invagination that results and in the extrusion of the ends of gut, one within the other, through the lateral opening. He then seizes the two long sutures and draws them apart, while the operator passes sutures of silk or horsehair, on straight cambric needles, one by one through all the coats of the bowel from one side to the other. These sutures are picked up within the lumen of the gut, cut here, and the two ends tied on each side. Enough of these interrupted sutures are to be provided to unite the ends closely throughout their circumference. The temporary sutures are now removed and the invagination is gently reduced. Lembert sutures are then provided for sewing the lateral slit and also to close any gaping spot in the line of anastomosis. After changing the towels catgut sutures are handed for the mesentery.

(3) *Lateral Anastomosis.* The assistant thrusts the edges of the bowel segments into their respective lumina one at a time, while the operator closes the ends with Lembert sutures of rather fine silk. The selected portions of gut are held together side by side while Halsted (square) sutures or one or two rows of Lembert sutures are inserted to unite them near the mesenteric border. Scalpel and scissors are then handed to make an opening in each segment to one side of the suture line, the assistant compressing bleeding points with hemostats. A long (continuous) suture of silk is then to be provided for "whipping over" the cut edges and uniting the two adjacent margins. Silk sutures are then needed for the serous surfaces to continue around the opening the line of Lembert or Halsted stitches first introduced. Catgut sutures follow for the mesentery.

(4) *By the McGraw Rubber Ligature.* The surfaces of gut or, in gastro-enterostomy, of stomach and gut, are held evenly in apposition while a row of Lembert sutures is intro-

duced. The rubber ligature is then passed. The assistant should select a firm round strand of rubber, not less than 2 mm. in diameter, and of good quality, and mount this in a straight round or Hagedorn needle. The needle having been passed into and partly out of one intestinal segment, the rubber is put upon the stretch while it is rapidly pulled through, the intestine being meanwhile properly steadied. The rubber is to be again stretched while it is passed through the other segment. While the operator holds it drawn tightly in a single knot, the assistant secures the latter by tying a stout strand of silk firmly about it. Silk and rubber are then cut short and sutures are handed with which to continue around the ligature the line of Lembert stitches first formed.

(5) *By the Murphy Button.* This instrument (appendix, fig. 48) consists of a "male" and a "female" half. The former bears a spring flange and, projecting from its stem, two spring metal points which act as a male thread when in the female stem. The two halves may be united by pushing the male into the female segment, but can be separated only by unscrewing them from right to left. Before the operation is begun, the assistant should thus separate the halves of the button or buttons provided, fastening an artery forceps firmly on each stem to serve as a handle for it.

By means of thumb forceps, the assistant lifts up one end of the intestine with the operator, while the latter introduces, usually with a cambric or straight Hagedorn needle, a "purse-string" or "puckering" suture of medium-sized silk, the ends of which are not to be tied nor cut. This procedure is repeated on the other segment.

One end of a button of appropriate size is then handed to the operator, by means of the attached artery forceps, in the manner and direction shown in figure 77. While the surgeon is introducing the button-half into one end of the gut, the assistant helps him in holding the latter open with thumb forceps. He then takes the artery forceps from the operator, and holding it vertically, maintains the button-half in position (*i. e.*, with its stem just projecting from the mouth of

the intestine), while the purse-string suture is tied down upon the stem and cut short. An assistant then holds this end of the gut, in such a manner that the button shall not drop into it, viz., by gentle traction on the attached artery clamp or by slightly compressing the intestine just beyond

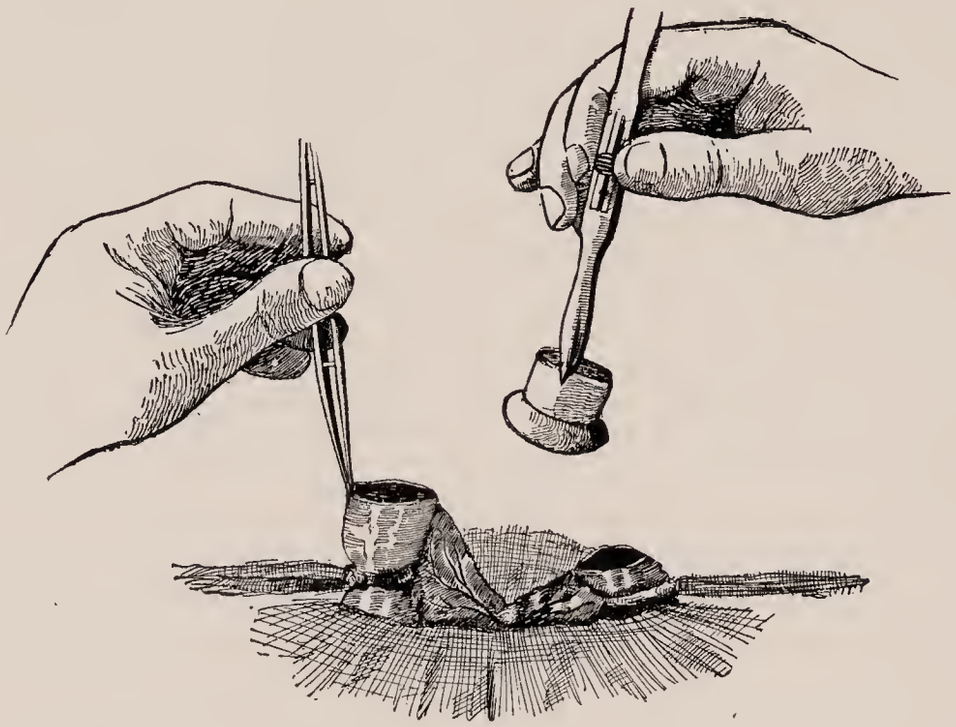


FIG. 77. Manner of handing half of Murphy button. Note gauze strips about intestinal segments and manner of holding gut for reception of button.

the button. The same manipulations are then repeated on the other segment of gut with the opposite half of the button. The assistant removes the artery clamps when the operator lifts up both ends of the gut to unite them. The parts are then gently sponged off. Reinforcing (Lembert) sutures may be called for. Sutures are next needed for the mesentery.

The technics of assistance in the introduction of the Murphy button for lateral anastomosis, cholecystenterostomy and gastro-enterostomy are quite similar to those just described. For the last named operation it is well to prepare, if possible, a button with one small and one large end. (Weir's modification). The large end is to be handed for

the jejunum, so that when necrosis has taken place the button will fall into the intestine rather than into the stomach.

(6) *By Senn's bone plates, Robson's bobbin, Laplace forceps or other mechanical device.* For the technics of employing these, the reader is referred to works on operative surgery.

CHAPTER XVIII.

ABDOMINAL OPERATIONS.—Continued.

OPERATIONS UPON THE FEMALE PELVIC ORGANS BY THE ABDOMINAL ROUTE.

OVARIOTOMY; SALPINGECTOMY.

For the removal of an *ovarian cyst* the assistant should prepare, in addition to the other instruments, straight and curved clamps, cyst forceps and volsella, aneurism needles (right- and left-handed), large curved trocar and canula (appendix, fig. 9), sponge handles and a Paquelin cautery. Stout silk or catgut will be needed for the pedicle and fine silk sutures may be required for sewing intestinal surfaces torn by the separation of adhesions. For such of the latter as are vascular, No. 2 catgut ligatures will be needed. Packings, pads, hot towels, mounted sponges and pus basins should be at hand.

After the abdominal wall has been divided, the wound should be held widely open with retractors while the operator studies the size, relations and character of the tumor. Protruding intestine should be restrained by means of gauze compresses, or, if necessary, the patient may be lifted at once into the Trendelenburg position. If the cyst is not sufficiently small and sufficiently free of adhesions to deliver it entirely from the abdominal cavity, packings are inserted all about the wound, through which the surface of the tumor is made to present. The trocar (or, lacking this, a scalpel) is then handed for tapping the cyst—in one place if monolocular, in several places if multilocular. As the puncture is being made, and while drainage is taking place, the assistant should press his hands firmly on each side of the abdomen,

both to facilitate the escape of the fluid and to prevent its leakage into the abdominal cavity. A basin or bucket should be arranged to receive the cyst contents.

A clamp is now handed for closing the puncture wound, and volsella for lifting the cyst wall out of the abdomen, retractors being inserted again to facilitate the exposure of adherent bands. For the division of these the operator may need blunt scissors, curved on the flat; the assistant helps by clamping all vascular adhesions before they are cut, and tying them afterwards, by carefully sponging away any escaping blood or cyst fluid, and by protecting surrounding viscera with fingers or compresses. For the pedicle the assistant now provides a clamp and a stout ligature. If the pedicle is not very thick, the ligature may be simply tied about it; if it is thick, however, the ligature should be mounted on an aneurism needle in order to transfix the mass, which is then ligated by one of the methods previously described. Amputation is then performed with scalpel or cautery, and the ligature ends are cut off. When the stump has been returned to the abdominal cavity, the assistant should expose with retractors the opposite tube and ovary for inspection. If the other ovary contains small cysts, the surgeon may desire to puncture them with a cautery point.

For an *intraligamentous cyst* scissors or scalpel will be required to split the peritoneal covering. If a pedicle exist, a stout ligature is required. Bleeding vessels need also to be tied. A suture is provided for reuniting the two layers of the broad ligament, with or without drainage.

An *ovarian abscess* or *pyosalpinx* requires of the assistant the same technics in its removal as above described. He should observe especial care, however, not to rupture the sac, and to prevent soiling of the operating field by any pus that may escape. Towels and compresses should therefore be provided to cover the intestines, even though the Trendelenburg position is employed, and a few sponges on handles should be kept within easy reach upon the patient's abdomen, throughout the operation. Gauze and tube drains should be prepared.

Ectopic Gestation. Hot salt solution in pitchers, several mounted sponges, a few clamps, stout mounted ligatures, and numerous packings, should be in readiness. If the patient is in shock from the loss of much blood, preparations ought also to be made for intravenous infusion.

Escaped or escaping blood must be quickly sponged from the pelvis, and clamps should be within the operator's reach to seize any large vessel that may be bleeding. The technics, in general, are as for simple ovariotomy—separation of adhesions, clamping, ligating, ablating. One clamp alone may suffice, but often the operator will require two—one at the uterine end of the tube and one to secure the ovarian artery at the edge of the broad ligament. Drainage through the vagina may be desired, especially where there is a large, old collection of blood in the pelvis (hematocele). To provide this, a pair of long-handled, sharp-pointed scissors, curved on the flat, is required. The assistant should protect the bladder and uterus from injury while the incision is being made in the vaginal vault. Through this opening a long dressing forceps is thrust from below to seize and draw down the drainage tube, or this forceps may be inserted first and the incision made over the tips of its blades, thrust into the posterior vaginal fornix.

In a case of advanced ectopic pregnancy, a suture will be needed to attach the cut edge of the gestation sac to the edges of the incision. For the umbilical cord, if the fetus is still alive, are required two clamps and a ligature. Long, wide gauze packings will be needed to fill the wound from the bottom.

HYSTERECTOMY.

The instruments to be laid out are: those needed for the dissection and retraction of the abdominal wall; several (six, at least) long, straight and curved clamps; aneurism needles (right- and left-handed); sponge handles; a bladder sound; long-bladed dressing forceps; and, if the operation is for a large tumor of the uterus, strong volsella. To these may be

added a Paquelin cautery and an aspirating syringe. The following ligatures and sutures should be prepared: those for the abdominal wall itself; fine silk sutures for torn intestinal surfaces; number 2 catgut ligatures for vascular adhesions; six stout catgut (No. 4) or silk ligatures for the broad ligaments; two long medium-fine catgut (No. 1) sutures on half-curved needles, for uniting the layers of the broad ligaments and sewing the peritoneal flaps over the cervical stump or the roof of the vagina. Several large packings should also be ready, as well as pads, hot towels, specimen dishes, etc.

Assistance is rendered in separating adhesions and in packing away the intestines and omentum in the manner described under ovariotomy. The uterus and its adnexa thus freed, and the patient's pelvis raised in the Trendelenburg position, the organ is drawn to one side, usually toward the operator, either by the surgeon or by the assistant. An appropriate aneurism needle bearing a stout ligature is then handed to secure the ovarian artery and upper portion of the exposed broad ligament. When the point of the needle has been thrust through the ligament—beneath the Fallopian tube if the ovary is to be saved, beyond the tube if the ovary is to be sacrificed—the assistant grasps the ligature with mouse-tooth forceps and draws one end of it completely through. (While this ligature is being tied the aneurism needle should be re-threaded.) A straight clamp is next required, to be applied distal to the ligature, and then scissors for dividing the broad ligament between ligature and clamp. Aneurism needle, clamp and scissors are passed in the same order a second, and if necessary a third, time, to secure the remainder of the ligament. The uterus is then drawn toward the side thus treated, and the opposite broad ligament is similarly attacked. An assistant may then insert a sound into the bladder (from below) if the operator signifies that he requires this in order to assure himself of the upper limit of this organ. Blunt scissors, curved on the flat, are then passed to the surgeon for dividing the peritoneum across the anterior surface of the uterus, and for stripping down peri-

toneum and bladder. When the location of the uterine arteries is determined, mounted ligatures are passed to secure each of them in two places, between which they will be divided.

If *supravaginal hysterectomy* is to be performed there is now needed a scalpel, with which to amputate through the upper portion of the cervix. Upon the stump the assistant holds a sponge temporarily. A basin is held to receive the uterus and the scalpel,—the latter being discarded because it may have been contaminated by organisms in the uterine canal. A cautery may next be desired to sterilize, by searing, the upper surface and the canal of the cervical stump. Some operators remove a wedge from the upper aspect of the stump in order to close it; for this purpose another scalpel or a stout pair of sharp-pointed, curved scissors will be required. A pair of mouse-tooth forceps and a running suture of catgut on a half-curved needle, are next handed to the operator for uniting the two layers of the broad ligament on each side of the cervix and for sewing the peritoneal flaps over the stump.

Where *complete hysterectomy* is to be performed, after the bladder has been stripped off and the uterine arteries secured, an assistant thrusts a pair of dressing forceps into the vagina in such a manner that the operator can incise through the posterior fornix along the line marked by the opened blades of the forceps. Small clamps should be ready for bleeding vessels on each side of the cut section of the vagina. A strip of gauze is prepared for insertion into the vagina after the cervix has been completely separated, and this gauze is drawn upon by an assistant from below until its upper edge is flush with the open vaginal vault. The running suture for the broad ligament is then handed as after the supravaginal operation.

Operator and assistant now sponge out the pelvis and remove pads, packings and retractors. The patient is lowered into the horizontal position, and sutures are handed with which to close the abdominal wound.

CESAREAN SECTION.

The usual instruments of dissection are all that are ordinarily needed, but it is well to provide clamps and aneurism needles also, for it may be necessary or desirable to perform hysterectomy or to sterilize the patient by resection of the Fallopian tubes. A stout rubber tube, a yard long (Esmarch constrictor) is also to be ready, although it is not required for hemostasis if there is a sufficient number of assistants at hand. Several sutures of stout silk in half-curved needles, and several of fine silk in full-curved needles, are to be prepared. There should be ready for the child a blanket, umbilical tape, "mouth wipes," and tubs of hot and cold water (although these latter will probably not be needed after a delivery by abdominal section).

After the division of the abdominal wall and the exposure of the uterus the rubber constrictor is handed to the operator if he requires its use. As it is slipped over the fundus and twisted about the lower zone of the organ the assistant should see that no segment of intestine is included in its grasp. The assistant now places a hand flat upon each side of the abdominal wall, pressing firmly downwards and backwards against the womb both to cause gaping of the wound against the surface of uterus, and to prevent the escape of blood and liquor amnii into the peritoneal cavity.

Clamps and scissors should be at hand for appplication to the umbilical cord as soon as the uterus has been cut through and the child extracted. The infant is received in a blanket by a nurse or other assistant who should be ready to give it whatever immediate attention it may require. The usually moderate escape of blood from the uterus may be sponged away, but the assistant who is compressing the abdominal wall should not remove his hands for this purpose; rather he should increase his pressure upon the organ. If the placenta is lying in the line of uterine section the hemorrhage will be profuse, however, and then the assistant may transfer his grasp to the lower part of the womb where he

is to compress the broad ligaments. If the rubber ligature has been used this may, instead, be simply tightened.

A basin is held to receive the placenta and membranes. When the uterus has been emptied and delivered through the wound the assistant should spread compresses beneath the organ. The surface of the womb is then sponged clean and fresh towels are rapidly spread about it, in preparation for the insertion of the sutures. The stout sutures are handed first in rapid succession. They are to be clamped one by one as they are passed, being tied and cut short after all are in place. The fine silk sutures for the serous surface are then provided, the assistant inverting and adapting the peritoneal margins as the stitches are tied. After this the compresses are removed and the abdominal wound is prepared for closure.

CHAPTER XIX.

ALEXANDER'S OPERATION. HERNIOTOMY.

ALEXANDER'S OPERATION OF SHORTENING THE ROUND LIGAMENTS OF THE UTERUS.

The assistant stands upon the patient's left side, opposite to the operator. A sharp scalpel is handed, and artery forceps are placed near by. The left side is first attacked, usually. If the assistant needs to help in steadying the skin for the incision, this must be done in a manner not to displace the latter from the line of the inguinal ring beneath. Bleeding vessels in the skin having been clamped, a sharp retractor is inserted into each side of the wound. By means of mouse-tooth forceps the assistant picks up the fascia and fat, with the operator. When the external inguinal ring has been exposed and the ligament drawn out the latter is clamped close to the opening, and a sterile compress is placed over the wound. The right side is then dissected in the same way. Fresh towels are now spread and short sutures (of chromicized catgut or silk), in half-curved needles are handed. These are for suturing the ligaments in the inguinal ring on the right side. The ligament is to be drawn well down by the assistant while these interrupted sutures are being inserted. During this manipulation the assistant should guard from inclusion in the stitches the inguinal branch of the ilio-inguinal nerve, which the surgeon has separated from the ligament. A clamp may be applied to each stitch as it is inserted until all are in place. With forceps the assistant brings the edges of the ring over the ligament while the stitches are being fastened. The deep sutures all tied, a ligature is provided for the projecting end

of the ligament in order to secure the bloodvessels that accompany it. A pair of scissors or a scalpel is next passed to remove the redundant end of the ligament; then silk or catgut stitches for the skin. The assistant covers the sutured wound on the right side with a compress, and again inserts retractors on the left side—where the sutures are now introduced. The dressings should be ample and may advisedly be covered with gutta-percha tissue to prevent soiling from below. It is secured with a double spica bandage (page 233).

VENTRAL HERNIOTOMY.

Preparations are made as for any laparotomy. Clamps and several stout (No. 4) catgut ligatures should be provided for ablating omentum, and numerous No. 2 ligatures will probably be needed for adhesions. Chromicized catgut (preferably "40 day"), kangaroo tendon, silkworm-gut, silver wire or silk will be used for the deep sutures, according to the surgeon's technic. Silver filigree (wire mesh) is sometimes employed, to be held by a few silver wire stitches in a gap that cannot be closed completely or with sufficient support, by autoplastic methods.

The anesthetist should keep the patient well "under" throughout the operation in order to prevent protrusion of intestine—for the protection of which, however, gauze packings and pads should be in readiness. The wound assistant helps in the separation of adhesions, usually present between omentum and sac, [in the ablation of omentum (page 140)], and in the adaptation of the aponeurotic flaps according to whatever method the operator indicates. If the hernia is a post-operative condition the assistant aids in exposing the retracted edges of the individual aponeuroses and muscles and in their approximation, in regular order, by sutures (page 191).

Over the dressing should be tightly drawn several straps of adhesive plaster in order to take as much strain as possible from the sutures.

INGUINAL HERNIOTOMY.

Bassini Operation. In addition to the other instruments of dissection there should be provided a pair or more of four-pronged sharp retractors, one or two blunt hooks, a few clamps, and about a dozen artery forceps. Several deep sutures of silk (as used by Bassini himself), forty day chromicized catgut, kangaroo tendon or horsehair—according to the surgeon's technic,—should be mounted in medium-sized, sharp, half-curved needles. In a fair-sized full-curved needle is to be mounted a suture of No. 2 catgut for the neck of the sac. Catgut or silk sutures in full-curved needles are to be ready for the skin. If a strangulated hernia is to be dealt with preparations should be made for intestinal resection, as previously described.

The scrotum or vulva and the upper part of the anterior aspect of the thigh, as well as the pubic and lower abdominal regions, are to be carefully shaved. The genitals and a large area of skin in the neighborhood of the groin should be thoroughly scrubbed with soap and water (under anesthesia) and carefully disinfected. Before the operation is begun the penis should be enveloped in a few turns of a sterile bandage or gauze strip, secured, without undue constriction, by means of an ordinary rubber band, sterilized by boiling. If the penis, although previously cleansed, is touched by the assistant's fingers while he is thus bandaging it he should disinfect his hands again before handling any instrument or towel—for strict asepsis is important to the success of the operation. To this end, also, it is very desirable that rubber gloves, caps and mouth covers should be worn.

The assistant aids in holding the skin taut for the primary incision and then in securing all divided branches of the external pudic arteries—for the wound must be kept as free from blood as possible. Retractors are next to be inserted in the skin to expose the cremaster and external oblique. Retraction of this muscular layer after its division then lays bare the cord. If the sac is not at once visible,

nor found by slight teasing of the cord structures with a pair of anatomical forceps, the operator will probably desire that the anesthetic be withdrawn temporarily in order that the patient may strain the sac into view. When it has been found, it is lifted up by the surgeon and the assistant by two mouse-tooth forceps, in order that it may be opened between them (figure 78). The assistant then clamps two or three artery forceps on the cut edge of the sac while the operator

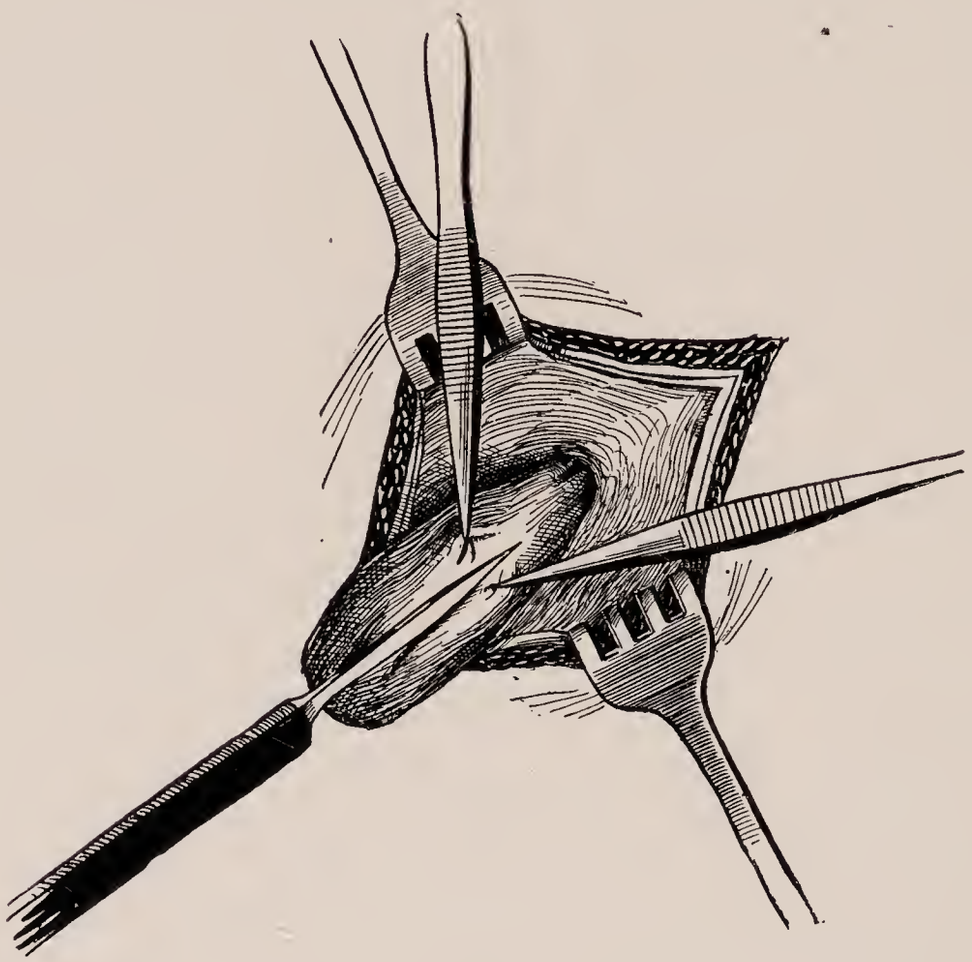


FIG. 78. Retraction of divided external oblique, exposing the sac, which is being opened between two mouse-tooth forceps.

explores its interior. If the hernia is of the congenital variety clamps are also affixed temporarily to the edge of the lower end of the sac, after it is divided.

The contents of the hernia determine the next step. Thus, if omentum presents, catgut ligatures are needed to secure its bloodvessels preparatory to its amputation; if strangu-

lated intestine is found, hot towels may be called for in order to test its viability; etc.

When the hernial contents have been dealt with a strip of gauze may be needed to insert into the neck of the sac to prevent protrusion of viscera, while the sac and cord are being separated. In aiding in this latter manipulation the assistant must use his anatomical forceps gently, for the pamp-

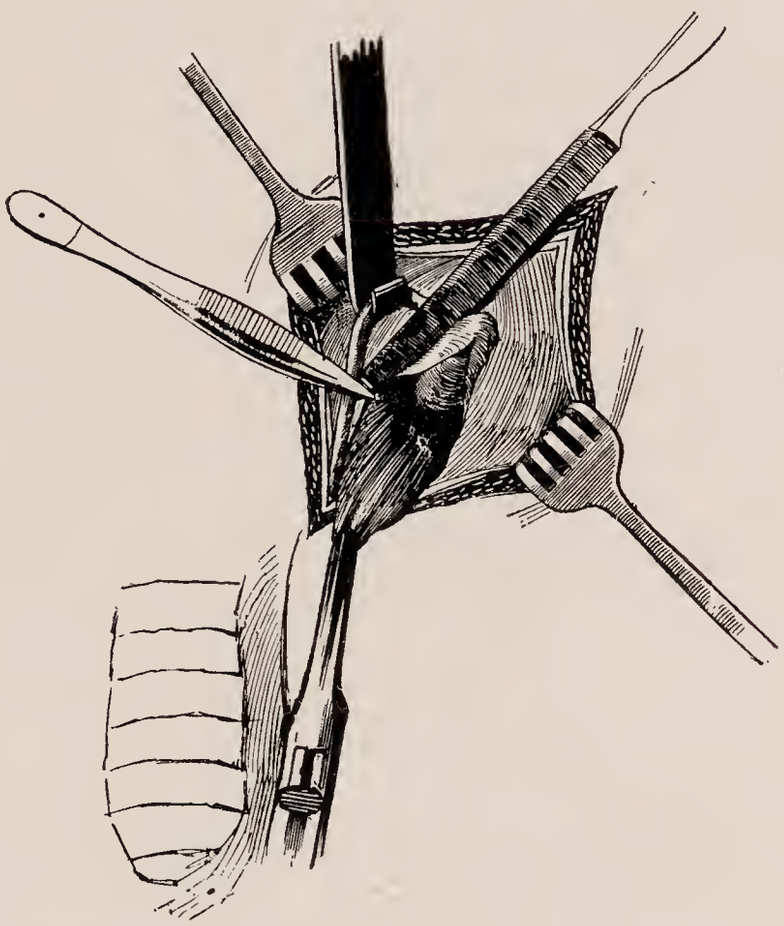


FIG. 79. Separation of sac from cord. Note bandage around penis, artery clamp attached to cut edge of sac, blunt hook lifting up cord.

inniform plexus is easily bruised and made to bleed. He should also guard the vas deferens against any injury by the surgeon's knife or scissors. The sac having been separated the assistant holds aside the cord structures by means of a blunt hook or fillet of gauze—again exercising gentleness in order to avoid pulling the testicle out of the scrotum or producing a hematoma in the cord.

The gauze strip now removed from the canal, the purse-string catgut suture is handed for insertion into the neck of the sac. While this is being introduced the assistant lifts up on the forceps attached to the sac, and as the purse-string is being drawn together he inserts a slender instrument, *e. g.*, a sponge handle, into the canal to prevent any protruding intestine from being caught in the ligature. After the first knot the sac is still held up while the ligature is passed once more about the neck; then scissors are handed to ab-

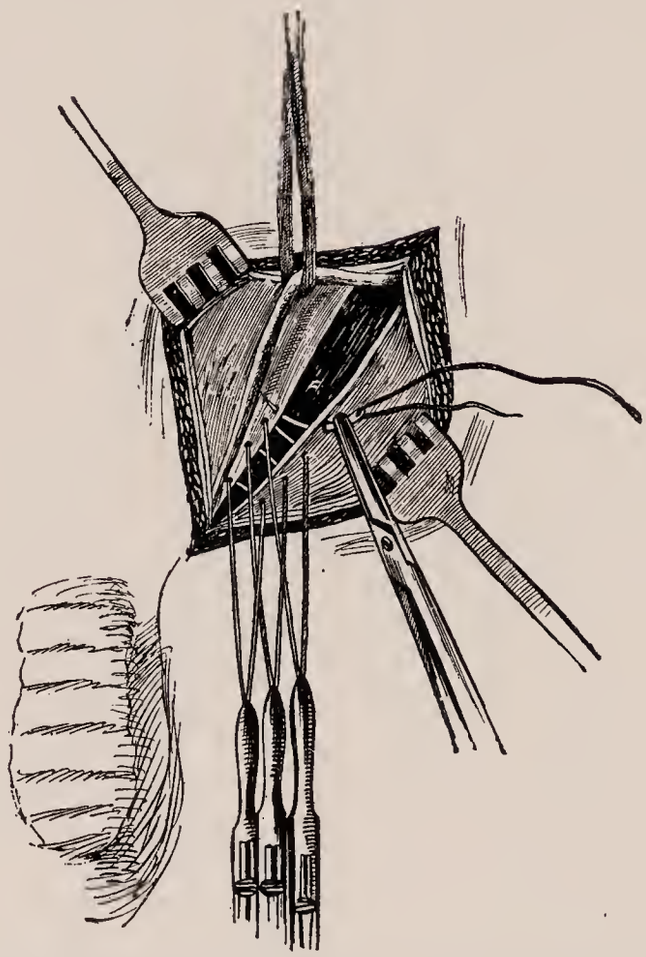


FIG. 80. Introduction of deep sutures. Sac has been tied and amputated. Cord is being drawn aside with gauze fillet. Sharp retractors expose internal oblique and conjoined tendon above, and shining inner aspect of Poupart's ligament below. Through these the needle is being passed. Artery forceps clamp the sutures, one by one, until all are to be tied.

late the sac and the catgut ends. If a congenital hernia is being dealt with a suture of No. 1 catgut is next needed to form, by means of a purse-string, a tunica vaginalis testis of the scrotal portion of the peritoneal pouch.

The cord still drawn gently to one side (toward the umbilicus), sharp retractors are next inserted into the external oblique, in order to thoroughly expose the internal oblique and conjoined tendon above, and into the aponeurotic insertions in Poupart's ligament in a manner to expose the shining inner aspect of this ligament below—as shown in figure 80. These retractors should be so placed that they bring the upper angle of the wound into view—for the operator may desire to incise the deep aponeurosis and trans-

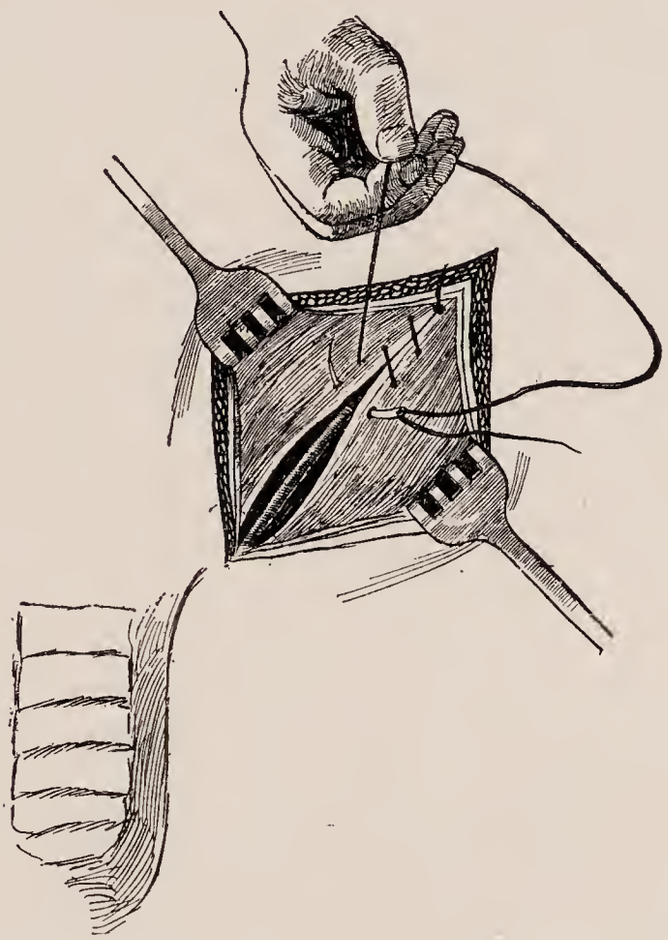


FIG. 81. Second suture layer, restoring the external oblique. Cord has been released and retractors shifted to the skin.

plant the cord to a new site of exit, or to insert a stitch in the internal oblique above the cord. Care should be exercised that the prongs of the lower retractor do not pierce the femoral vessels lying just beneath Poupart's ligament.

The (interrupted) deep sutures are then handed. As they are inserted into the conjoined tendon above and the

ligament below they are, one by one, "cut long" and secured in artery forceps. When all are in place they are handed to the operator again in regular order, for tying; and after all are tied they are cut short. The wound is then sponged out, the cord released and the retractors removed to the

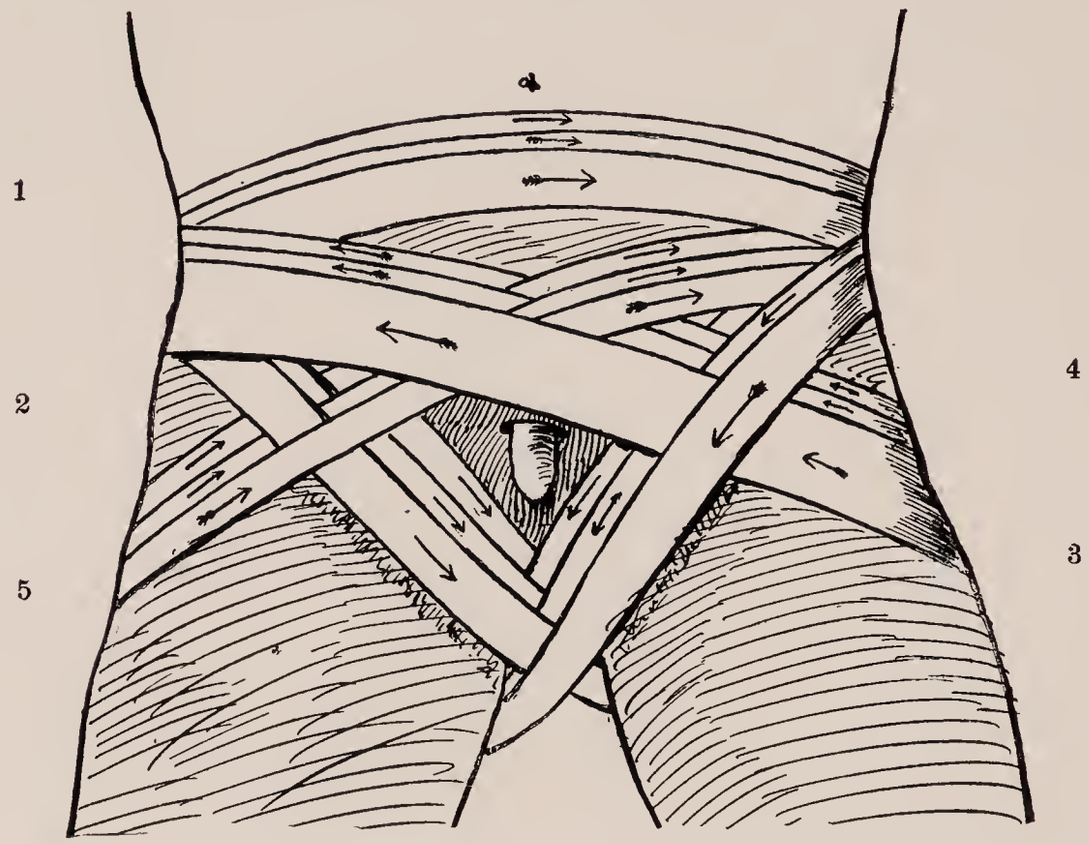


FIG. 82. Diagram showing turns of bandage in dressing after inguinal herniotomy.

skin. Next are handed interrupted or running sutures with which to unite the edges of the external oblique (figure 81). After this the wound is again sponged and the skin sutures are provided. Before these are introduced the operator may want a running suture for the fascia.

A pad of gauze is to be held over the groin, while the towels are being removed and a hip rest slipped under the lumbar region. While gauze pads and a single spica bandage will suffice, it is better to apply the dressing to a male patient in the following manner. The groin is evenly filled with gauze pads and absorbent cotton, and loose gauze is placed over the scrotum, which is to be *held up*. Over the

iliac spines a little absorbent cotton is placed. To prevent soiling of the dressing a sheet of gutta-percha, perforated for the penis, may be used to cover it. The bandages, six inches wide, are applied as shown in figures 82 and 83. A few circular turns, over the iliac crests, are first passed. Then the roller is brought down over the right groin and the scrotum, across the perineum, behind and around the left thigh (in the gluteo-femoral line), around the abdomen again, from the patient's left to right in front and from his right to left behind, down over the left groin and the scrotum, across the perineum and behind the right thigh, etc.—thus forming a double spica, or figure-of-eight bandage crossing the per-

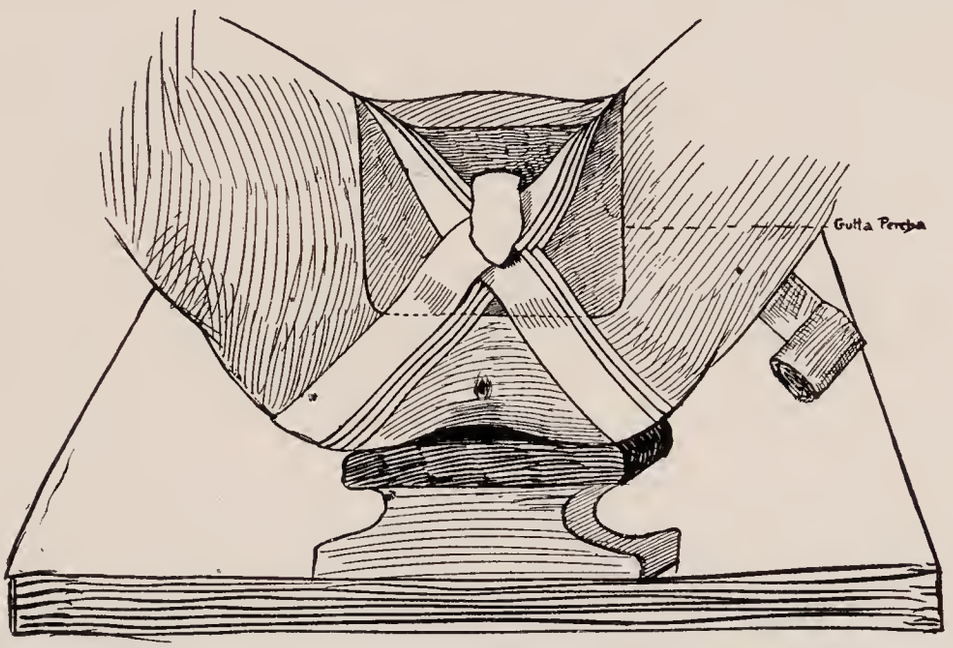


FIG. 83. Diagram showing perineal turns of bandage in dressing after inguinal herniotomy.

ineum (in front, of course, of the anus). A few turns of a starch bandage may be applied over the gauze bandage. For female patients a single or double spica should be so applied that the vulva is left free.

The technics of the assistant in herniotomies by other methods than Bassini's, need no separate description. Reference to a work on operative surgery will indicate to him the modifications he need make of the above details, in Halsted's, McEwen's and other operations.

FEMORAL HERNIOTOMY.

The assistant's manipulations here are also but an adaptation of those described for inguinal herniotomy. A catgut (purse-string) suture is needed for the sac; and silk or chromicized catgut sutures for the canal,—either another purse-string, or two or more interrupted stitches, as used, for example, to unite Poupart's ligament and the pectineal fascia.

CHAPTER XX.

OPERATIONS UPON THE KIDNEY AND URETER.

OPERATIONS UPON THE KIDNEY.

LUMBAR ROUTE.

The patient is laid upon his side, the affected kidney uppermost. Under the opposite loin is placed a cylindrical or triangular cushion, about eight inches in diameter. Lacking either of these an ordinary bed pillow may be rolled tightly into a cylinder, secured with a bandage, and covered with rubber sheeting or oilcloth. The patient's lower arm lies under the chest, the forearm being free; but the anesthetist should change the position of this extremity from time to time to avoid pressure paralysis. The other arm is held across the chest in an easy position by pinning the sleeve to the shirt. The head rests on a pillow. The chest and the lower extremities should be covered with blankets. The entire abdomen and back are to be disinfected. When the sterile towels are spread about the field of operation it will be wise to pin to the others those covering the belly and the back, lest they otherwise fall. It should be remembered too, that, because of the patient's position, instruments laid upon the body are apt to fall, and they should therefore not be allowed to accumulate there.

The instruments required for *nephrectomy* are: those ordinarily needed for dissection, a ligature carrier or aneurism needle, two or more clamps (if a large neoplasm is to be dealt with several clamps should be provided to secure adhesions), an aspirating syringe with a long needle of generous calibre, and sponge handles. Since rib resection is occasionally necessary it is well to provide also periosteal

elevator, raspatory, osteotome and bone hook. For the pedicle there should be at hand, for the operator to select from, ligatures—about twelve inches long—of solid rubber, of heavy twisted silk and of stout catgut (No. 4 to No. 6). Several gauze compresses about four inches wide and sixteen inches long, of four to eight thicknesses, are to be cut and folded. The wound sutures to be prepared are usually of stout braided silk, or one or two strands of silkworm-gut, in heavy full-curved needles; these sutures being supplemented by catgut for the skin and, sometimes, by chromicized catgut for the muscles.

For *nephrotomy* the same instruments and materials should be ready as for nephrectomy, since the necessity for the removal of the kidney may develop in the course of the operation. In addition, spoon forceps are desirable, narrow gauze drains and drainage tubes. These last (which may even be called for after nephrectomy too) should be of red rubber, preferably, half an inch in diameter and about eight inches long. Two are all that are apt to be required, and ordinarily they need not be fenestrated. An irrigator, containing hot salt-, or weak sublimate-solution, should be at hand. To re-unite a kidney that has been split in exploration or for the removal of a calculus, sutures are required of No. 3 catgut in long, sharp, full-curved needles, and of No. 2 catgut in smaller half-curved needles.

For *nephropexy* the instruments of dissection are all that are needed, the sutures to be prepared depending upon the operator's choice of technic.

The assistant faces the patient's abdomen, standing, if necessary, on a foot-stool. The help to be rendered in the division of the lumbar muscles and the exposure of the kidney bed is as described for lumbar colostomy.

If the kidney does not at once appear satisfactorily in the wound the assistant presses the fingers of one hand upwards and into the abdomen in order to thrust up the organ and he thus holds it until the operator has it securely in his grasp.

Nephrectomy. Ligatures may be required for bloodves-

sels at the poles of the kidney that have to be severed in the course of the delivery of the organ. When the surgeon has reached the pedicle, the assistant should have a clamp at hand, lest a rupture of the renal artery or vein should inadvertently take place. If the pedicle is to be ligated *en masse* with a rubber strand the assistant secures this ligature with a long piece of heavy silk, knotted tightly around the rubber at its point of crossing. The silk thread is left long, the rubber cut moderately short. Silk or catgut ligatures to be tied around the individual vessels should be in ligature carriers. They are usually left long in order to expose the

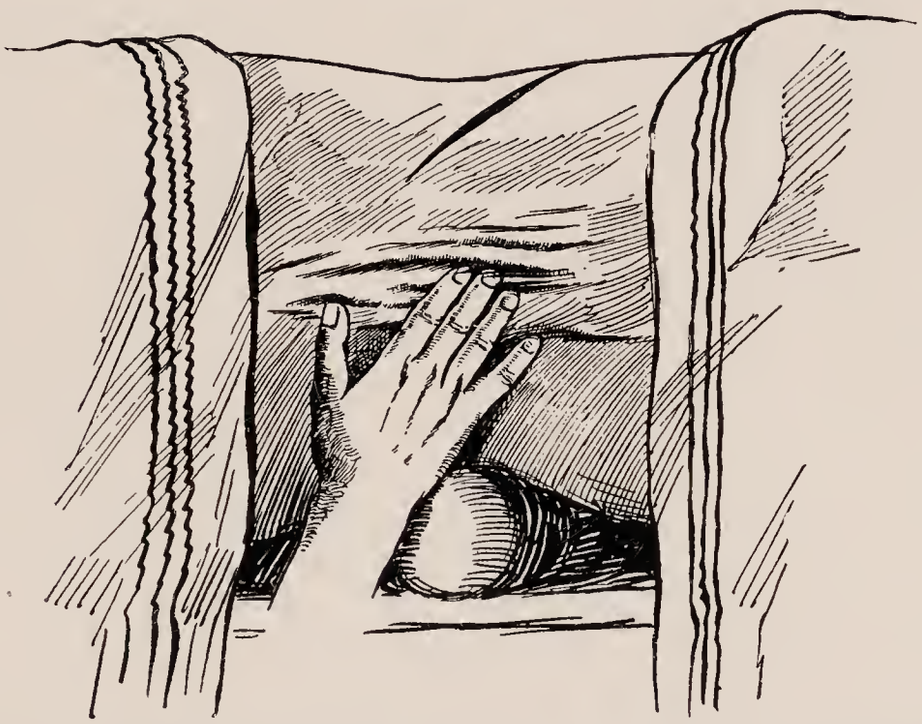


FIG. 84. Assistant pushing up the kidney by pressure on the abdomen. Note the cushion under the lower loin.

pedicle in the event of bleeding after the kidney is removed. The slipping of one of these ligatures is an accident the possible occurrence of which the assistant must bear in mind. To meet such a condition the emergency clamp above referred to should be kept within easy reach until the very conclusion of the operation. In some cases the operator will find it necessary to leave one or more clamps on the pedicle instead of, or in addition to, the ligatures. In that event

the assistant holds the instruments lightly in a vertical position, carefully avoiding traction, while gauze packings are inserted all about to support them. A large ring of loose gauze is to surround the handles beyond the wound, and a firm dressing is to be so applied that they cannot move about.

Usually a single drain of gauze, sometimes of tubing, is to be supplied, the greater part of the wound being closed with the sutures above mentioned. If, for any reason, the wound is to be left open, several gauze packings will be needed, with or without a "Mikulicz bag" (page 122). The dressing should be abundant and compressive.

Nephrotomy. Unless the condition of the kidney is at once evident the aspirating needle and white specimen dish will probably be wanted as soon as the kidney is well exposed. To maintain this exposure the assistant may be obliged to continue manual pressure upon the abdomen throughout the operation. Sometimes, however, especially when the kidney has to be split through the greater part of its length, he may be required, instead, to pass the thumb and forefinger of each hand beneath the organ to compress the renal vessels,—this to prevent suffusion of the field and undue loss of blood. Similarly the operator may desire a clamp or a ligature to temporarily constrict the vessels. In such cases the compression is to be maintained until the manipulations of the kidney are concluded.

All stones that are removed should be received in a dish. The drainage required for a calculous kidney must be indicated to the assistant by the general condition of the organ. If the wound in the kidney is to be closed, after section or resection, there are handed first the No. 2 deep catgut sutures, in half-curved needles, and then the No. 3 sutures, in heavier full-curved needles, to be passed through the kidney and tied over its convex border. The first set of stitches may not be needed, however. If a uro- or pyo-nephrosis is to be evacuated, packings should be handed for insertion about the kidney, and the patient's body should be tilted somewhat backwards. A pus basin is to be held beneath the wound, and two drainage tubes are to be ready for in-

troduction. Through these the operator may wish to irrigate. Gauze packings will be needed around them to partly or entirely fill the wound, as the surgeon may decide. Upon the surface of the wound an abundance of loose gauze is to be placed, and over this, flat compresses, with or without a covering of rubber tissue, and a firm bandage.

Nephropexy. In the operation of Edebohls according to his own technic, the patient is placed prone upon the cushion, *i. e.,* in the position of ventral decubitus. For the performance of the operation by other methods the lateral position is to be employed.

The assistant aids in exposing the kidney as for nephrectomy or nephrotomy. In the most modern methods partial or complete stripping off of the fibrous capsule of the organ is undertaken. For this purpose the assistant provides scalpel and mouse-tooth forceps. The sutures, to be passed through the kidney or the capsule, or both, are of chromicized catgut, silk or silkworm-gut, according to the technic employed, and according as they are intended to be absorbed or to be removed. During their introduction the assistant is to hold the kidney up in its proper place. A gauze tampon may be called for, to be introduced beneath the lower pole of the organ.

ABDOMINAL ROUTE.

The removal of a large tumor, or the removal or evacuation of a large cyst, of the kidney, undertaken trans-peritoneally, either deliberately or in the course of an exploratory operation, requires the same preparations as for laparotomies in general. Several gauze packings, clamps and ligatures, and an aneurism needle will be needed in dividing adhesions, and active sponging in the depth may be required and should also be provided for. An aspirating syringe is to be in readiness, and volsella, too, may be called into requisition. If a cyst is to be dealt with the assistant should prepare a running catgut suture, in the event that the surgeon may desire to attach the sac to the parietal peritoneum,

before draining it. A narrow packing will then also be needed to reinforce the line of suture. After nephrectomy, the recess behind the peritoneum may require the preparation of suitable gauze drains; for the peritoneum itself the operator may want a catgut suture.

OPERATIONS UPON THE URETER.

To properly expose the ureter,—after lumbar dissection, or after lateral abdominal incision and stripping up of the peritoneum—the assistant will be called upon for the intelligent manipulation of large sharp and blunt retractors. To remove a calculus, he will hand a scalpel, a slender pair of dressing forceps and a dish; and after these, either a fine suture of catgut or silk, or simply a narrow gauze drain. To re-unite the ureter, after injury or after the excision of a stricture, the assistant should provide fine sutures of catgut and of silk, having both straight and small full-curved needles threaded for the operator's selection. Silk is used for the deep sutures only in those methods of end-to-end or lateral anastomosis or invagination that do not require these stitches to pass through the inner coat of the ureter. When the assistant is required to lift up the ureter in his forceps, in order to help in the anastomosis, he must carefully avoid undue traction, for it is important that the ureter should not be detached from its bed any more than is absolutely necessary.

CHAPTER XXI.

OPERATIONS UPON THE BLADDER AND URETHRA.

CYSTOSCOPY IN THE MALE.

For this manipulation there should be prepared: the cystoscope and its lighting attachments; a large hand-syringe, preferably of glass; a soft rubber catheter, about No. 21 French; lubrichondrin, sterile vaselin, sterile olive oil or other lubricant; a basin of warm sterile water or salt solution; [an Ultzmann- or small hand-syringe]; [cocain solution, 2 per cent.]; bichlorid of mercury solution, 1-1000; a few cotton sponges; a sterile towel or basin, on which to lay the cystoscope; [ureter catheters]; a pus basin; [specimen tumblers]; [a bistoury]; a black cloth about a yard square.

The patient is placed in the "lithotomy position,"—the buttocks at the end of the table and the legs and thighs flexed. If a general anesthetic is administered a Clover's crutch, Edebohls' or Robb's leg-holder, or a twisted sheet, may be applied to retain the lower extremities. Otherwise it is best to have them held comfortably in position by some one standing beside the patient and facing the operator. Under the buttocks should be placed a towel; and the lower extremities should be protected from undue exposure by leggings or some other covering (*e. g.,* pillow cases).

By means of cotton sponges, the assistant first cleanses the glans penis with soap and water, and then with sublimate solution. If the operator thinks it necessary, a few drops of the cocain solution may next be instilled through a (lubricated) Ultzmann syringe (appendix, fig. 86) or catheter which, with the same technic of asepsis as is described on page 255 for the introduction of steel sounds, is passed *into* the neck of the bladder and gradually withdrawn as the

cocain is injected, so that the latter is distributed along the urethral canal. The catheter is then passed into the bladder and the urine drained off into a pus basin. By means of a hand-syringe, the bladder is irrigated through the catheter with sterile water or salt solution until the liquid returns clear; after which as much of six ounces of the fluid as the bladder will hold, are injected and the catheter is withdrawn. A chair or stool is placed in position for the examiner at the foot of the table, and the cystoscope itself is then made ready for use.

If the instrument is in carbolic or other antiseptic solution, it should be rinsed off in sterile water, *handling it only by the butt.* The lighting apparatus (battery or modified "street current") and the cystoscope lamp should be tested with a gradually increasing current, the assistant determining the strength of the latter than which the lamp could probably not stand more without "burning out." A milliamperemeter will afford a statement of this datum. The instrument is then dipped in the lubricating solution and handed to the examiner for insertion. If it is found that the meatus is too small to admit the cystoscope, the bistoury will be called into requisition for the performance of meatotomy.

The cystoscope in position, the black cloth is thrown over the head of the surgeon and the lower end of the patient to exclude the light—unless, of course, the room can be darkened. The current is again turned on gradually until the examiner is satisfied with the illumination, but it should not be increased beyond the limit previously determined upon. If, with an amperage found sufficient in the preliminary test, the field remains dark, the connections are faulty or the window of the cystoscope is covered with blood—in which latter case the instrument must be withdrawn and cleansed, or the bladder washed out with the apparatus in situ if an "irrigating cystoscope" is being employed.

If ureter catheters are used they should be lifted from the formalin jar or other container with forceps and passed to the operator on a sterile towel for, being at best very difficult

to sterilize, they ought to be handled as little as possible. If catheters are left in the ureters after the removal of the cystoscope, their ends may be dipped into test tubes, and each catheter and tube strapped to the inner surface of the corresponding thigh of the patient with adhesive plaster—thus to collect urine from each kidney separately while the patient is in bed.

During cystoscopic manipulations the patient, if unanesthetized, will probably suffer considerable discomfort, and it is well for the assistant to reassure him from time to time in a low voice.

A soon as the examination is concluded, the current is to be turned off, thus giving the cystoscope a moment to cool before it is withdrawn. As soon after use as convenient, the parts of the instrument should be cleansed and sterilized, as described on pages 103 and 108, then dried and re-assembled.

For *Urethroscopy (Endoscopy,* appendix, fig. 93), the preparations are simpler and the manipulations fewer. The patient occupies the extended recumbent position—unless the posterior urethra is to be explored, in which case the lithotomy position will probably be desired. The glans is to be cleansed, and the light tested, as in cystoscopy. The endoscope, lubricated, is handed to the examiner with the obturator in place, the lamp being attached after the latter is withdrawn. Several slender applicators should be mounted with cotton, to mop out the canal and to apply nitrate of silver or other medicament to it.

CYSTOSCOPY IN THE FEMALE.

(Kelly-Pawlik Method.)

Here are needed: Kelly cystoscopes, urethral dilators and suction apparatus; urethral calibrator; applicators; cocain solution; catheter; pus basin; cotton sponges; sublimate solution; lubricant; sterile towels; and head mirror or frontal lamp.

The patient is first placed in the lithotomy position, and the vestibule cleansed with a sponge dipped in sublimate

solution. The labia are separated with the thumb and forefinger of the left hand, and the urine is withdrawn with a rubber, glass or metal catheter held, near its open end, between the right thumb and middle finger. Before passing the catheter, the opening of the urethra should be accurately determined, and if the tip of the instrument inadvertently comes in contact with other parts of the vulva, it should be re-sterilized. The ball of the index finger is to be held against the mouth of the catheter while it is being introduced and again while it is being withdrawn. That part of the catheter which is to enter the bladder should not be handled. Having emptied the organ [and cocainized the urethra by means of an applicator], the assistant hands to the examiner the urethral calibrator, and then a dilator of the same size as the urethra. Successively larger dilators are handed until the operator is satisfied with the distention of the orifice. Then a lubricated speculum, of the same caliber as the last dilator, and with its obturator in place, is provided. When it has been inserted and the obturator withdrawn, the patient's pelvis is elevated on a cushion. If the operator notes that the bladder does not satisfactorily balloon out, the assistant should place the patient in the *knee-chest position.* Indeed, it is in this posture that the examination is most often conducted. In it the patient rests upon her knees and shins, with the toes over the end of the table, the trunk being flexed upon the thighs, and the upper part of the body being supported upon the chest, the right forearm and the right side of the head. Patient and instrument in position and the room darkened, the assistant turns his attention to the manipulation of the light and the preparation of applicators.

SUPRAPUBIC CYSTOTOMY.

In addition to the general instruments, there are usually needed: a hand-syringe, catheter, lubricant, irrigating solution, and basin, as for cystoscopy; [rubber rectal bag]; two long stout silk guy-sutures threaded on half-curved needles; one curved blunt retractor; [a pair of long, narrow, right-

angled blunt retractors]; small sponges on long handles; drainage tubes; narrow gauze packings; [urethral sound]; [head light]. For the removal of a calculus there may also be needed stone-spoons and stone-forceps (appendix, fig. 96); for prostatectomy, long-bladed scissors curved on the flat and volsella; for neoplasm or ulcer, a Paquelin cautery.

The patient is placed in the full recumbent position. The pubic region is shaved and the skin disinfected in the usual way. With the soft rubber catheter, the assistant empties the bladder of urine, and, if the latter is turbid, irrigates the viscus, by means of a hand-syringe attached to the catheter, with salt-, boracic acid-, or weak (1-5,000) sublimate-solution until the fluid returns clear. He then injects into the bladder about eight ounces (for an adult) of air or of the solution, according to the operator's preference, and withdraws the catheter. If distention of the rectum is also desired, he next introduces, beyond the internal sphincter, the folded and lubricated rectal bag, inflates it gradually with eight to ten ounces of air or fluid, and then clamps the attached tube. Some surgeons prefer to distend the bladder under the guidance of the eye, *i. e.*, after the transversalis fascia has been exposed in the course of the operation. After these manipulations, the assistant should "scrub up" again thoroughly before spreading the towels about the field of operation.

The skin and subcutaneous fat having been divided in the median line ("high cystotomy") or, less commonly, in a transverse direction, pronged retractors are inserted in order to expose the muscles. If the median dissection is being followed, the assistant then, with mouse-tooth forceps, picks up the linea alba with the operator in order that it may be nicked with the scalpel and slit up with scissors or knife. The divided aponeurosis is then drawn aside with the retractors. The exposed transversalis fascia is next similarly picked up and, after division, retracted. The operator having drawn upwards the prevesical fat and the fold of peritoneum, the assistant holds these with the blunt retractor in the superior angle of the wound. The two guy sutures are next handed

to the operator, one at a time, for insertion into the presenting surface of the bladder. The free ends of each suture are made even in length and are knotted together or secured in hemostatic clamps. The assistant then provides a narrow

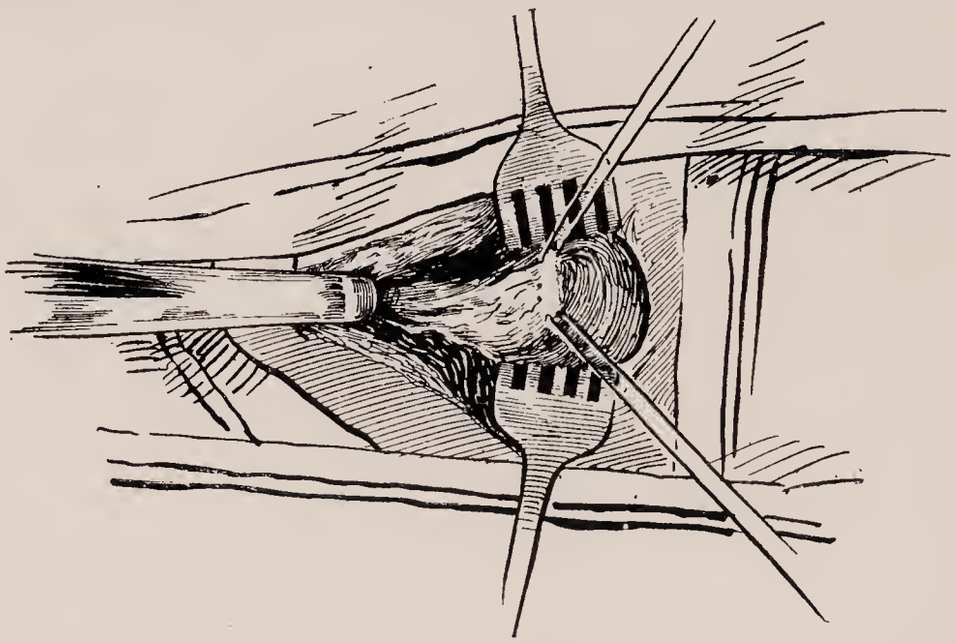


FIG. 85. Suprapubic cystotomy. Bladder exposed and prepared for incision. Retractors in sides of wound. Blunt retractor holding up peritoneal fold and prevesical fat. Guy-sutures inserted in bladder.

scalpel or bistoury and draws upon one of the guy threads in a direction away from that in which the operator draws upon the other suture.

If the bladder has been filled with fluid, it is important, while the latter is escaping after the puncture, to prevent its entrance into the perivesical tissues, by using absorbent gauze and by keeping bladder and abdominal wall as much as possible in contact. Straight scissors are needed to enlarge the opening.

Lithotomy. For the removal of stones the surgeon may need only his fingers, or he may require stone-forceps or stone-spoon. Cylindrical speculum, chisel and mallet may, rarely, be called into requisition before an encysted stone can be made small enough to deliver through a narrow opening (Fenwick method). In such a case the assistant, with a finger in the rectum, supports the stone while it is being broken.

If the operator decides to close the bladder wound, the assistant provides him with a running suture of fine chromicized catgut for the mucosa, and somewhat coarser chromicized gut or silk for the muscular-serous coats; chromicized catgut again for the aponeurosis; and catgut, silk or aseptic adhesive strips for the skin. A short, narrow gauze drain is prepared for the lower angle of the wound. The latter is to be covered with an ample gauze dressing, secured by a snug binder or double spica bandage.

If, however, the bladder is to be drained, a smooth, but not too soft, rubber tube, about ten inches long, is provided. One or two fenestrations may be made near the extremity that is to enter the bladder. A few sutures will probably be needed for the aponeurosis and for the skin, if not also for the bladder. A split compress, surrounding the projecting tube, is placed over the wound and covered with gauze pads and a bandage so applied that the tube passes through them unconstricted. A safety-pin or adhesive strap then secures the tube to the bandage so that it will not slip. Another device to prevent displacement of the tube consists in surrounding it, like a collar, with a snugly fitting larger tube, which is split in half through part of its length, the divided portions being spread out upon the skin and fastened down with adhesive plaster.

Prostatectomy. The assistant mops the unescaped fluid from the bladder with sponges. Then, after handing the long curved scissors and a volsellum to the operator, he passes his left hand [covered with a rubber glove] under the patient's thigh and introduces the index finger into the rectum. This is for the purpose of pressing up the prostate gland and of notifying the operator when his own finger approaches the rectum in the process of enucleating the gland. [If the surgeon desires to provide perineal drainage, he is handed an urethral sound, unlubricated. The assistant then removes the towels, separates the patient's thighs and provides a scalpel to incise the perineum where the tip of the sound has been made to bulge into it, and a stout drainage tube mounted on dressing forceps, for introduction as the

sound is being withdrawn. See *perineal section.*] Long strips of gauze are required for tamponing the bleeding floor of the bladder, and others for the bladder cavity itself. The gauze dressing should be ample and the bandage tight. A sandbag may be placed over it for six or eight hours, to limit hemorrhage.

Neoplasm: ulcer. Here the narrow-bladed right-angled retractors are often needed, and a strong headlight may be very desirable. The Trendelenburg position may also become necessary. The actual cautery may be called into requisition, or applicators dipped in nitrate of silver solution or other medicament.

If the bladder is resected, the assistant should expose the field well, clamp bleeding vessels and sponge frequently and quickly. Sutures will be needed for the mucosa and for the outer coats. The surgeon may desire to pack the bladder in part and drain it with a tube, or to pack it completely.

When suprapubic tube drainage is employed, the assistant arranges the following mechanism after the patient is returned to bed: The projecting tube is connected by means of a glass canula with a long piece of rubber tubing which passes over the edge of the mattress and is attached to the long arm of a glass T tube, fastened to the mattress with a safety-pin. From one of the short arms of the T a rubber tube leads into a carbolic or sublimate solution in the bottom of a pail, placed at the side of the bed. The other short arm is connected with tubing leading from an irrigating bottle suspended near the head of the bed, and containing a weak sublimate solution. The flow of this solution from the bottle through the short arms of the T tube syphons the urine out of the bladder. By constricting the tube leading from the irrigator with a hemostat, clothespin, hairpin, or other device, the rate of flow may be reduced so that the solution escapes into the pail drop by drop—thus making replenishment necessary only at comparatively long intervals (figure 86). The tubing running from the bladder drain to the glass T should be sufficiently long and flexible to allow the patient to move about, and it should be prevented from kinking

over the edge of the mattress by fastening under it at that point a piece of stiff curved cardboard or other device. A glass S tube may be introduced into the discharging pipe

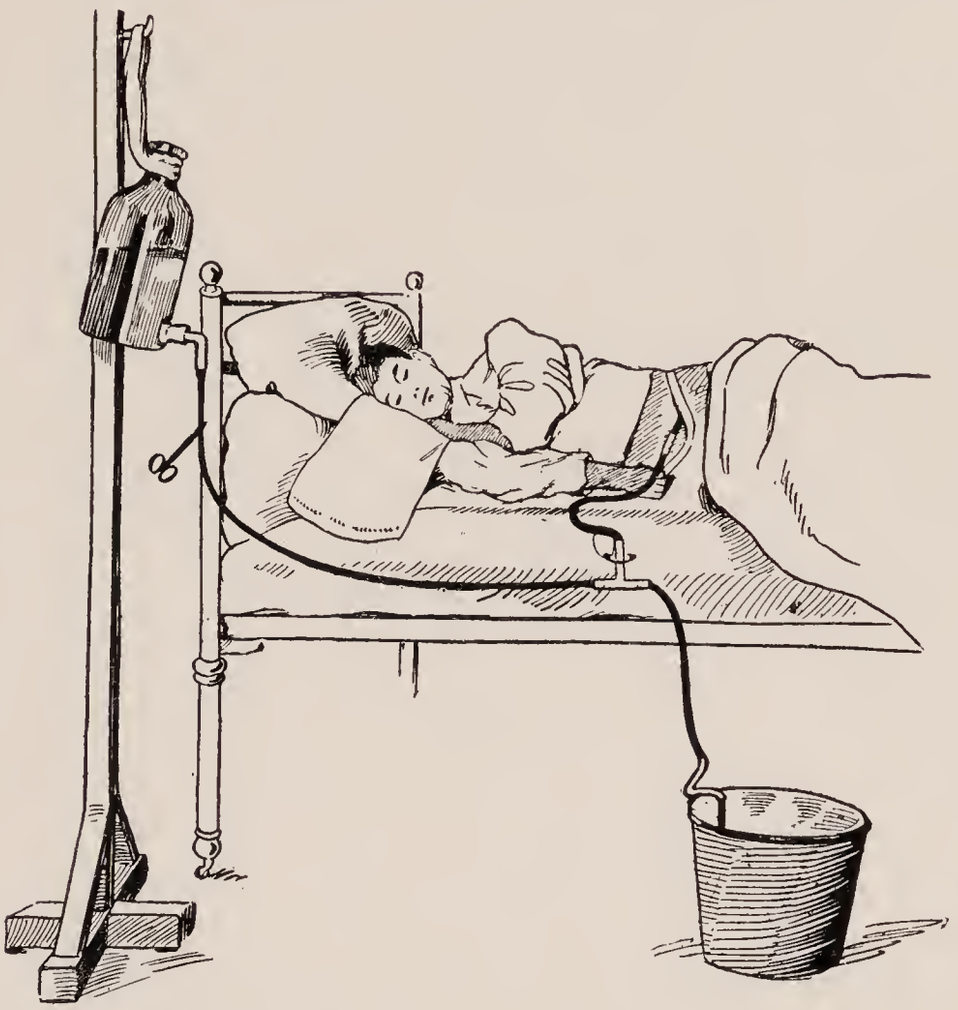


FIG. 86. Arrangement of syphon for suprapubic drainage of the bladder.

near, or inside of, the pail to form a trap, but this is not essential.

Perineal drainage requires no syphonage. The perineal tube, held in place with a safety-pin under the bandage, if not actually stitched to the skin, is attached by means of a glass canula to a tube leading under one of the patient's knees, and into a bottle containing an antiseptic solution, suspended under the edge of the bed.

In both forms of drainage it is desirable to keep the centre of the glass coupler uncovered by tubing, in order to observe the passage of blood clots, etc.

INTERNAL URETHROTOMY.

The appliances needed depend upon the character of the stricture and, in part, upon the technics of the operator. Speaking generally, it is well, if possible, to have ready the instruments necessary for the internal division of all sizes of stricture since, for example, after cutting through one stricture, a tighter one may be discovered more deeply located. The following supply of instruments (illustrated in Appendix 2, pages 347, 348) will meet all conditions: Otis urethrometer; probe-pointed bistoury, or Gouley's beaked knife; a set of steel sounds, up to No. 35 French, or even 40 French; an assortment of filiform whalebone bougies, of bougies à boule and of olive-pointed bougies; a soft rubber catheter, about No. 18 French; "English catheters," Nos. 25, 30 and 35 French; hand-syringe; urethrotome of the Otis type; urethrotome of the Maisonneuve type; [cocain or eucain solution]; boracic acid- or weak sublimate-solution; lubricant for sounds and catheters. Since perineal drainage may become necessary even when not originally intended, the asisistant should also have at hand: a scapel; a pair of medium-sized sharp retractors; a pair of small sharp retractors; [a small round blunt retractor]; two mouse-tooth forceps; one anatomical forceps; one long dressing forceps; hemostats; needle holder; half-curved needles; two or three silk sutures; catgut ligatures; a gorget or grooved director; straight and curved scissors; a probe; a catheter or piece of smooth tubing of the caliber of 30 F.; narrow packings; safety-pins; perineal dressing.

The patient is placed in the lithotomy position with the back flat upon the table and the median line of the perineum kept always in the strict vertical. After shaving, the penis, scrotum, perineum and buttocks are cleansed with soap and water and then with sublimate solution. *Only when a patient is fully narcotized should a stiff brush or alcohol or ether be used in disinfecting the genitals.* The urethra distal to the stricture may then be washed out with the irrigating

solution. If a local anesthetic is to be employed this is next instilled by the assistant.

Instruments for determining the site and caliber of the stricture, or strictures, are first handed. The urethrometer may suffice for the purpose, or there may be required an assortment of bougies à boule or, for narrow passages, of filiform bougies. If only fine instruments will pass, one of the filiform bougies belonging to the Maisonneuve urethrotome is handed to the surgeon for insertion; then the grooved staff of the instrument is provided for attachment to this filiform guide, and then the wedge-bearing stylet itself, to slide along the staff and cut the stricture from without inward. For strictures of larger caliber, or if desired for tight strictures *after* division with the Maisonneuve instrument, a urethrotome of the Otis type is handed, with which to cut from within outward. While the stricture is being cut with any form of urethrotome, the assistant, seizing the glans penis, should hold the organ on the stretch in the horizontal plane and in the median line of the body. A lubricated steel sound, of the size to which the stricture has been cut, is handed to the surgeon after he withdraws the urethrotome.

If perineal drainage is to be provided *(Combined Urethrotomy)* the assistant, standing on the patient's left, passes his right forearm over the abdomen and lifts up the scrotum with the fourth and fifth fingers of the right hand. Between the thumb and the index and middle fingers of the same hand he takes from the operator the handle of the steel sound left in situ in the urethra, and holds it in such a manner (viz., inclined toward the abdomen), that the penis is nearly vertical, and the sound bulges in the perineum (fig. 87). An incision having been made down to the sound, retractors are inserted into the urethral wound in the perineum and the staff is withdrawn. Then [a grooved director and] a drainage tube mounted in the beak of a dressing forceps are handed.

The tube in place, the retractors are withdrawn and a

narrow packing may be provided for insertion around the drain. To hold the latter in position it should be transfixed by a large safety-pin. A suture may also be called for to anchor the rubber to the skin. A split compress is applied beneath the safety-pin, and loose gauze is laid about the tube. A *T bandage,* preferably of unbleached muslin, is then applied. Of this the arms encircle the waist, while the tail is

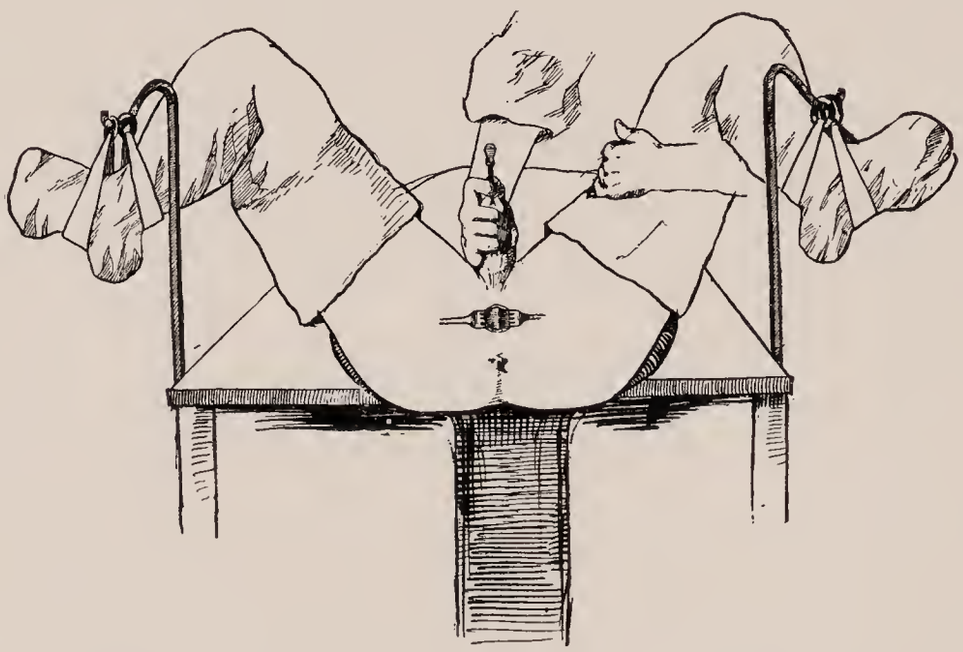


FIG. 87. Manner of holding scrotum, penis and urethral sound in external urethrotomy.

[NOTE.—Straps of leg-holders are here drawn outside of leggings to show method of arranging them—properly the leggings (which are split) should cover straps and leg-holders.]

brought from behind the patient's body over the perineal dressing and pinned in front to the other arms. This perineal strip is perforated to admit the passage of the drainage tube and split further forward to surround the scrotum and penis.

EXTERNAL URETHROTOMY AND "PERINEAL SECTION."

The instruments, etc., to be at hand are those mentioned above for internal urethrotomy and perineal drainage, and in addition grooved urethral staffs (Syme's, Wheelhouse's, etc.,—appendix, figs. 94, 95). The patient is placed in the lithotomy position. It is desirable to have at hand a flat

cushion upon which the buttocks may be raised if necessary. In addition to the disinfection of the field as described above, it is well to sponge out the rectum. The assistant should seat himself at the foot of the table on the right of the operator. If, however, there is no second helper to hold up the scrotum, penis and staff, the assistant should stand on the patient's left side, lifting the genitals with his right hand and employing his left hand in aiding at the wound and in handing instruments.

Syme's Operation. A grooved staff is handed to the operator at first or after he has sounded the urethra with bougies. Syme's staff has a narrow tip to enter the stricture, a shoulder to rest on the face of the stricture and a wider portion above the shoulder. The staff having been inserted its handle is taken from the operator and held, with the penis and scrotum, in the manner described above and illustrated in figure 87. A narrow-bladed scalpel is then provided. The staff having been exposed and the stricture divided, the instrument is to be withdrawn upon signal from the surgeon. A full-sized sound is handed to test the canal.

Then a full-sized gum-elastic catheter is handed to provide drainage. The operator may elect to pass this through the entire urethral canal, or to insert it through the perineal wound. In either case a grooved director may be called for to guide the catheter into the bladder. If it is passed at the meatus the wound is lightly packed and covered with a simple gauze dressing held by a T binder; the tip of the catheter is secured to the penis with adhesive strips, or to the dressing with tapes. If the catheter is passed through the perineum, it should be transfixed by a safety-pin near the wound, and cut off three inches beyond; a narrow gauze strip may be needed to insert about the tube, and split compress, loose gauze and T binder are applied as described under "combined urethrotomy." When the patient is in bed, the catheter drain is to be coupled to a tube leading into a pail or bottle.

Wheelhouse's Operation. A Wheelhouse staff is handed with the groove towards the operator. When it has been

inserted it is held by the assistant as in figure 87. Scalpel, mouse-tooth forceps and hemostats are then passed. When the urethra has been divided two small hooks, or volsella or guy threads, are needed to hold it open laterally. The retractor or volsellum on the right side is to be held by the assistant. The latter relinquishes the staff to the surgeon. When the instrument is re-adjusted so that its button tip engages in the upper angle of the urethral wound, the assistant takes the handle again and draws upwards upon it gently. Next a right-angled, probe-pointed, grooved director and a narrow scalpel are handed for dividing the stricture while the wound is thus held open. Artificial light may be needed for this procedure. The remaining steps are essentially as in assistance at Syme's operation.

External Urethrotomy without a Guide—Cock's Operation. The scrotum and penis are held up and the patient's body is steadied so that the median line of the perineum is kept vertical, while the surgeon plunges a sharp, narrow-bladed scalpel towards the apex of the prostate. When the knife is withdrawn, a probe-pointed director is handed, and then a large gum-elastic catheter, straightened on its stylet. The catheter is cut short after insertion, and the perineal dressing applied.

Median and Lateral Lithotomy. These require, essentially: grooved sounds of size suited to the patient's age, scalpel, probe-pointed bistoury, grooved director, and stone forceps. The assistant, standing on the patient's left side, holds the grooved sound (straight or curved) in the exact position directed by the surgeon—usually drawn well up and with the handle tilted towards the abdomen in order to bring the membranous urethra close to the perineum. The director is needed after the scalpel, and then the stone forceps. The drainage and the dressing are as above described.

Perineal Prostatectomy. The ordinary dissection instruments, long-handled sponges, volsella, one or two sounds and long scissors are needed. Rectal and bladder tractors in the form of rubber bags, etc., are used by some operators. The assistant, seated at the right, will be concerned almost

entirely in the manipulation of wound retractors, in sponging and in securing bleeding vessels. Strips of (iodoformized) gauze about four inches wide should be in readiness for packing the wound.

It is often necessary that the surgical assistant should know

How to pass a Steel Sound or other Unyielding Urethral Instrument. Gentleness and cleanliness are of utmost importance. The hands should be disinfected, and the sound made aseptic by boiling. Lifted from the sterilizer it is rinsed in sterile water and dried with a sterile towel, on which latter it may be laid until needed. One should be able to pass a sound with either hand, and from either side of the patient, or while standing between the thighs flexed in the lithotomy position. By choice, however, the operator stands upon the left of the patient, who lies in the recumbent posture with the head raised and the thighs slightly flexed and separated. The penis is held in the left hand. The prepuce is retracted and the glans cleansed by means of absorbent cotton, first with soap and water, and then with sublimate solution. The sound is taken in the right hand, *touching the instrument always at its handle only,* and its tip is dipped in sterile olive oil or glycerin or anointed, by means of the towel, with lubrichondrin or vaselin. The back of the right hand rests on the patient's abdomen, just below the umbilicus. The sound is lightly poised between the thumb and the index and middle fingers, with its tip towards the penis and the concavity of its curve towards the floor. The third and fourth fingers of the left hand lifting the penis by the corona glandis, the thumb and index finger press open the meatus so that the sound will come into contact with the mucous membrane only, as its tip is introduced. The two hands are now made to approach, the sound being gently urged into the penis—by scarcely more pressure than its own weight—and the penis being drawn up over the sound. The left hand is now withdrawn and the handle of the sound is carried down slowly at right angles to, and in an arc occupying the

midplane of, the body. When the handle reaches the level of the thighs, it is transferred to the left hand, by which it is slowly depressed between the limbs. A resistance is felt as the tip of the sound enters the prostatic urethra. This yields after a moment when, with a further depression of the handle and slight urging of the sound, the instrument slips past the neck of the bladder. In withdrawing, the handle is to be carried through the same arc in the reverse direction.

CHAPTER XXII.

OPERATIONS IN AND ABOUT THE VAGINA.

The table, prepared with drainage pad, etc., as shown in figure 14, is located, if possible, so that the light falls upon its lower end and in the general direction of its length. A drainage receptacle is arranged at the foot of the table, and here also are placed two stools or chairs—one for the operator on the left, the other for the assistant on the right. A low table (or board laid on chairs) is so placed that the assistant can reach the instruments upon it with his right hand, without moving from his seat.

In the performance of curettage, trachelorrhaphy, etc., there is occasionally employed the

Sims' Position (figure 100). The patient lies on her left side with the left buttock at or just overhanging the end of the table near the corner corresponding to the operator's left. The head lies near the right side of the table. The left thigh, at an angle of about 70 degrees with the body, is almost parallel with the lower end of the table, the corresponding leg projecting beyond the table. The right thigh, overlapping the left, is flexed more acutely, the right foot lying about over the left calf. The patient's back is thus directed somewhat upwards and towards the operator's left. When this position is used, a nurse stands at the patient's back to hold, with one or with both hands, a Sims or Sims-Mundé speculum (appendix, fig. 111) which she draws upon in such a manner that the posterior vaginal wall is approached to the sacrum, thus to expose the cervix uteri.

Usually the ordinary *lithotomy position* is employed. The patient is laid on her back with the buttocks in the drainage pad, and just projecting over the table. The lower extremities are separated and flexed and held by means of knee sup-

ports, Edebohls' leg-holders, the twisted sheet or Robb's leg-holder, a Clover's crutch, or simply by the hands of a second assistant. They are to be covered with [sterile] leggings or pillow cases or wrapped in sterile towels.

Preparation of the Field. For curettage, drainage of a pelvic abscess or similar minor operation involving no suturing, the operator will probably not require that the patient

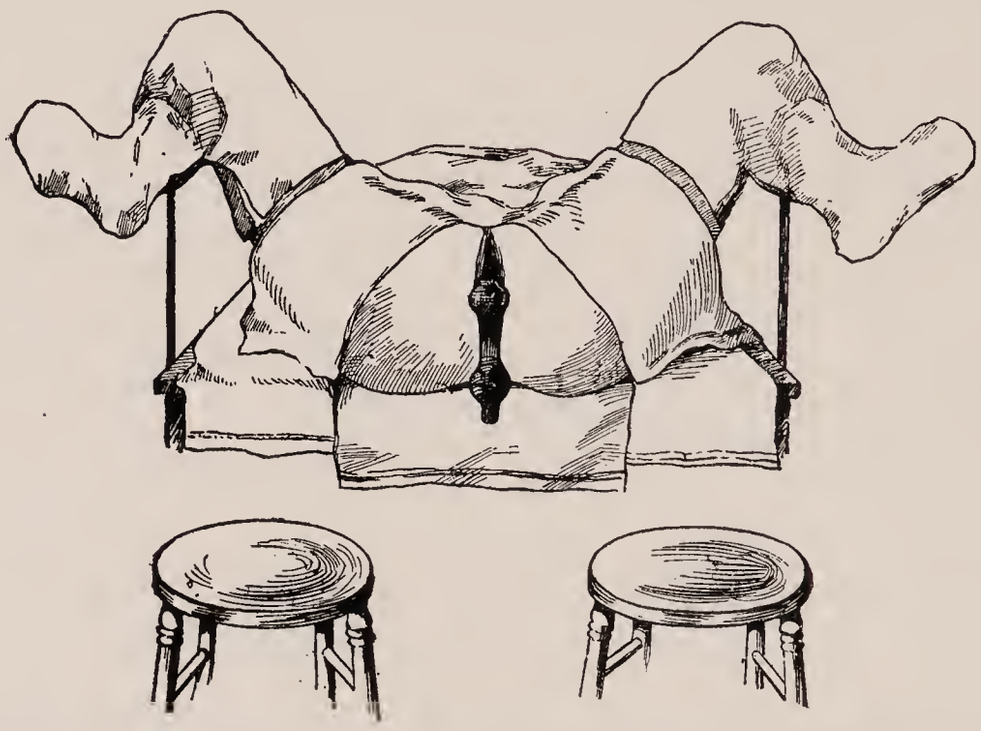


FIG. 88. Arrangement of table, towels and chairs for perineal operation. Legs held in Edebohls' holders. Weighted speculum in place.

be shaved. In other cases, however, the hair should be carefully removed from the labia and perineum, the mons veneris being shaved or not according to the nature of the operation.

After removing from the vagina with forceps or by means of irrigation any excessive secretion that may be present, the assistant scrubs the canal with soap and water. For this purpose he may use a jeweler's brush. This has no bristles at the tip, and therefore hardly cleanses the presenting surface of the cervix; moreover, the bristles may lacerate the vaginal mucosa. It is better therefore, in most cases, to use a sea-sponge or gauze mop mounted in the tip of a clamp or pair of dressing forceps; or the assistant may simply use

two fingers to rub the soapsuds over the cervix and vaginal walls. The vagiña is then washed out with sublimate solution, 1-5,000. This may be directed into the canal from an irrigator, or poured in from a pitcher. The pitcher is held just over the vulva, and the vagina is made to receive the fluid by hooking the perineum out with a finger introduced over the fornix. By alternately stretching down and pressing in the perineum, the canal may be filled and emptied several times. The hypogastrium, external genitals, per-

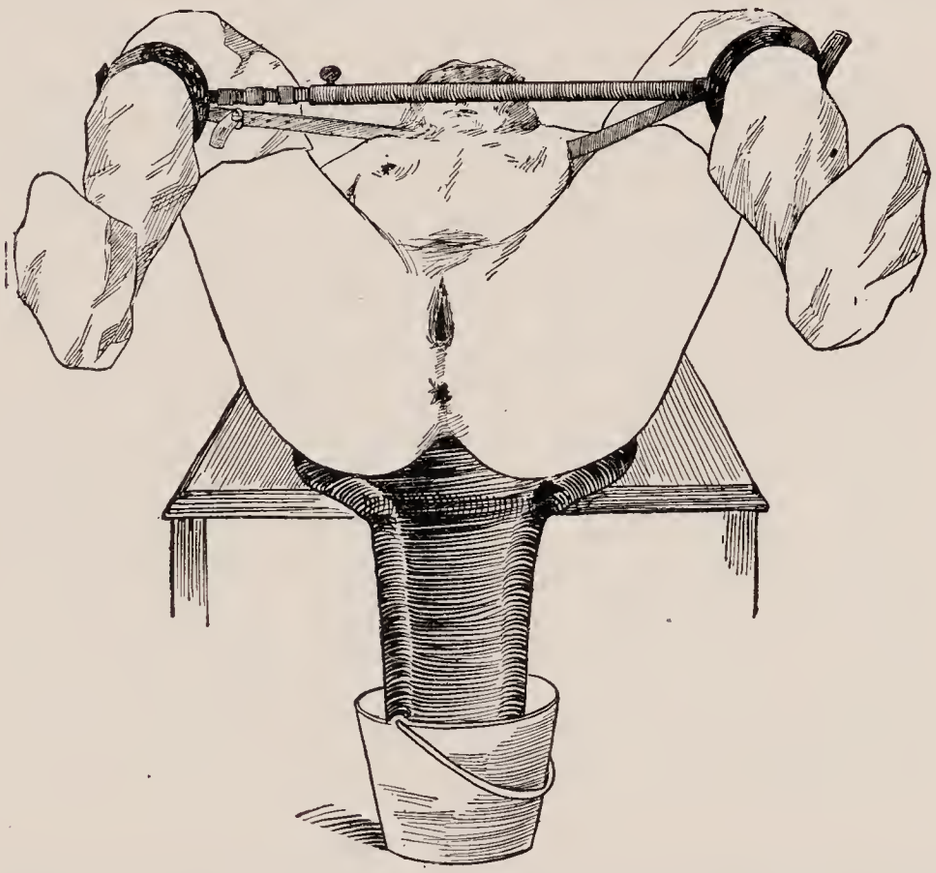


Fig. 89. Manner of applying Clover's crutch. (Appendix, Fig. 97.)

ineum, buttocks and inner surface of the thighs are then thoroughly scrubbed with soap and water, wiped off and washed with sublimate solution, 1-1000 or 1-2000. The urethral orifice is easily lacerated by the bristles of a hand-brush, and if it be even only bruised the patient will complain of dysuria for some days thereafter. A soft cotton mop should therefore be used for cleansing the vestibule. The labia may be pressed together during the scrubbing of the skin, to prevent the entrance of soapsuds into the vagina.

If this happens, however, the canal may receive a final douche. Fluid remaining in the posterior fornix should be mopped out, or evacuated by depressing the perineum.

The assistant having disinfected the operating field and his own hands and forearms, dons his gown. He lays a towel over each of the patient's thighs, another across the abdomen and a fourth one over the edge of the table and under the buttocks. Seating himself on the right, he spreads a towel on the operator's lap and one on his own—these to hold instruments from time to time. Where a single assistant is re-

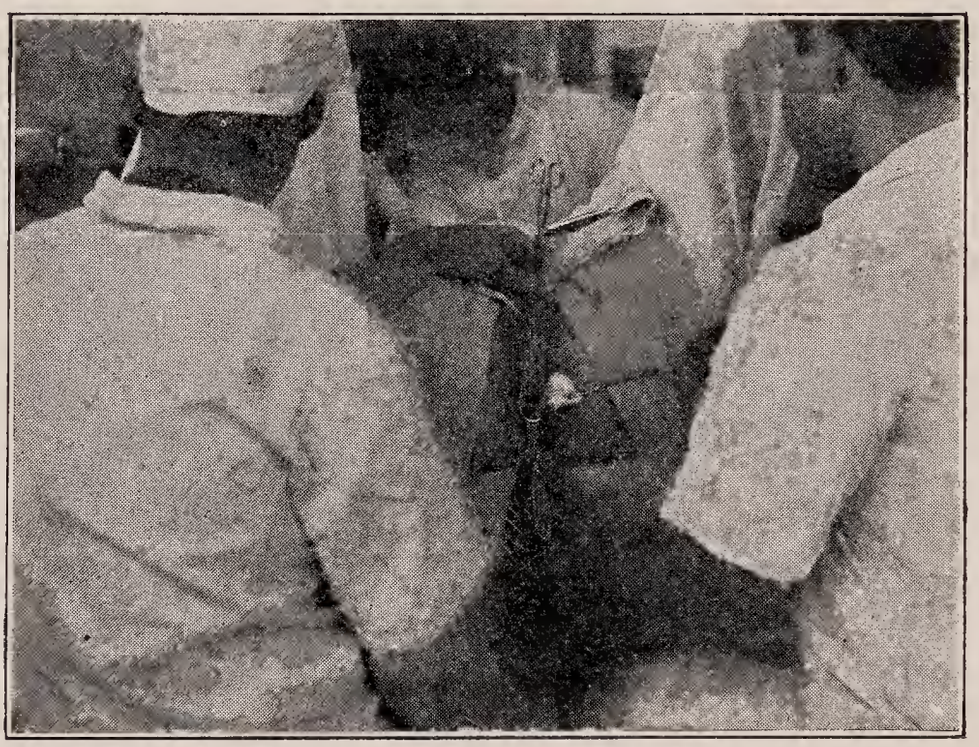


FIG. 90. Disposition of operator (on the left) and of assistant (on the right) in vaginal and perineal operations. Note positions of hands and forearms.

quired to perform additional duties, as for example to aid in supporting the legs, it is sometimes advantageous for him to remain standing. In any case, he will do well to wear, under his gown, a stout rubber apron that reaches quite to the floor, to protect his garments from being wet.

CURETTAGE.

The instruments (appendix, figs. 98-112), should be arranged on the table in the order in which they are to be

handed, viz.: specula, volsellum, uterine sound, small cervical dilator, large dilator, curettes, intra-uterine irrigating tip and attached piece of rubber tubing, and slender dressing forceps or uterine "packer," and, for the assistant's use, sponge holders, anatomical forceps and straight scissors. With the two last named instruments, there should be lifted from the jar and prepared two strips of plain or iodoformized gauze an inch wide, and another strip about three inches wide. Neither in preparing these strips nor in passing them to the operator need the assistant touch them with his fingers. A vulva pad of gauze and a T binder will be needed for the dressing, but they may be applied after the patient is put to bed. An irrigating solution of bichlorid of mercury, 1-10,000 to 1-5,000, or of plain water, and having a temperature of 120 degrees, F., must also be prepared.

If the vulvar outlet is large, no speculum may be required, the cervix being exposed merely by drawing it down with the volsellum. Otherwise the operator is handed first the speculum, *e. g.*, a self-retaining weighted speculum (appendix, figure 108) which, as its name implies, will not have to be held in place. Then there are handed in succession the volsellum, the uterine sound and the small dilator. In passing these the assistant holds them by their shanks, their shafts in the direction of the vagina and their handles towards the operator. As the dilator is handed to the surgeon, he is relieved of the sound. If the dilators have set-screws, the assistant should note before passing them that they are so placed that the handles can at once be manipulated. When the small dilator is withdrawn, it is to be taken from the operator's hand and the larger one substituted. After completing the dilatation (a process that is not required when the cervical canal is already open, *e. g.*, immediately after a miscarriage), the surgeon is ready for the curette. In operating for endometritis, he will probably desire first a small blunt curette, then a small sharp one, and then the same or a narrower sharp instrument for the cervix. For the removal of placental tissues of considerable size, the surgeon

will use placental forceps or (and) a large blunt curette, or his finger only. Irrigating curettes are used by some operators; when needed, they are to be attached to the tube leading from the irrigating bag. During the performance of the operation, the assistant usually need only sponge out the vagina from time to time. It will be well for him to save the bits of tissue collected by the sponge for the operator's subsequent inspection. A specimen dish may be kept at hand for the collection of material brought away with the curette. The surgeon may desire the assistant to hold the volsellum occasionally; this he is to do in such a manner that the cervix is drawn towards the urethra.

The curetting completed, the intra-uterine douche is to be supplied. After attaching the "recurrent" douche point (*e. g.*, Bozemann's), the assistant should allow the solution to run upon his left hand,—without touching the instrument to it, however—in order to determine that the first, cool, portion of the fluid is drained off, before passing the canula to the operator. After the douche the vagina is mopped out, if necessary, and the first narrow strip of gauze is handed. It is to be seized by a corner in the very tip of the slender uterine dressing forceps, and frayed strands picked off with thumb forceps. If, in its passage from the instrument table to the uterus, the gauze touches the vulva, the vagina or even the surface of the cervix itself, it should be discarded. To prevent the escape of the gauze with each withdrawal of the forceps from the uterus, the assistant may hold the packing in the cervix by the pressure of a uterine sound. Indeed, a sound may be used, probe-like, to introduce the gauze. The employment of a uterine gauze-packer obviates the tendency of the strip to come out with the introducing instrument;—one end of the gauze is mounted on the spiked end of the stylet, thrust through the tube, and thus handed to the surgeon.

After the first strip has been used (to remove all shreds of tissue not evacuated by the irrigation), the second one is handed. When this is in place the volsellum is withdrawn, and the wider gauze packing, referred to above, is provided

for the vagina. Gauze vulva pad and T binder constitute the dressing.

In the performance of Mundé's *discission and dilatation* a long, straight, slender, probe-pointed bistoury is needed before the gauze drain, about an inch and a half wide, is put into the uterus.

TRACHELORRHAPHY.

This requires, in addition to the instruments for curettage, a long pair of mouse-tooth forceps; [a tenaculum]; a scalpel; a long pair of sharp-pointed scissors, curved on the flat;

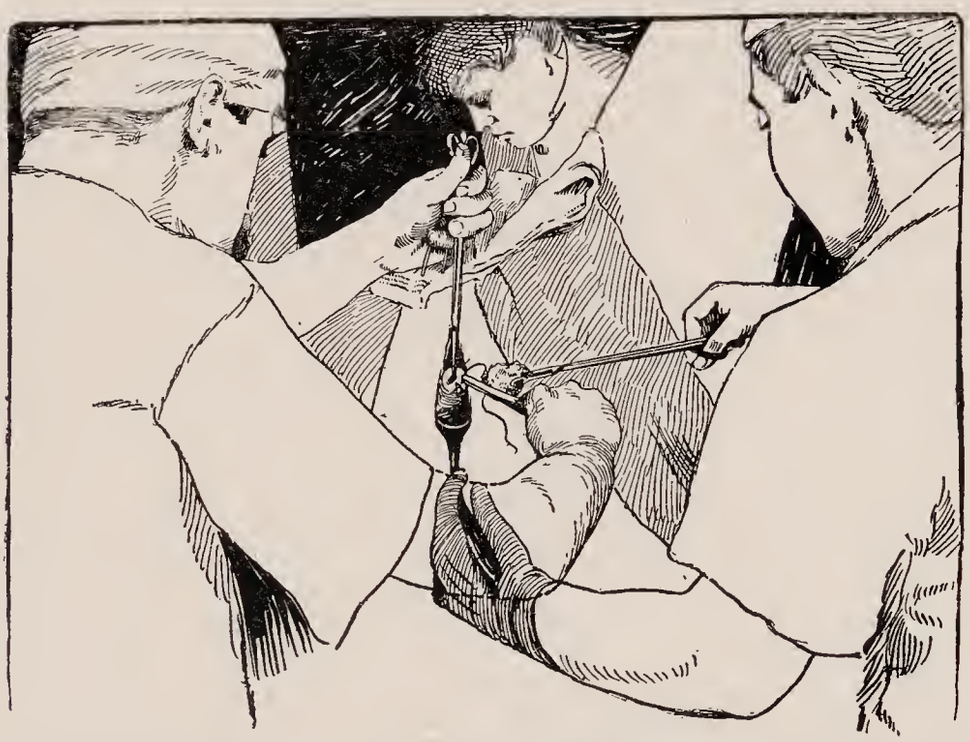


FIG. 91. Disposition of surgeon, assistant and anesthetist in trachelorrhaphy. The operator has taken the volsellum in his left hand while introducing the stitches. Assistant's right hand manipulating sponge; his left hand is here shown through the operator's arm to indicate method of holding posterior vaginal retractor (spade).

needle holder; "cervix needles" (see appendix, figure 27) or stout full-curved needles of about the same length; a few artery clamps; and, if silver wire is used for stitching, the wire twister, scissors, shield and "counterpresser."

Whatever material be used—silkworm-gut, silk, chromicized catgut or silver wire, four or five sutures, each about

nine inches long, should be prepared in advance. Ligature material should be at hand, although it is not often needed.

While the surgeon is preparing the wound surface with mouse-tooth forceps or tenaculum and scalpel or scissors, the assistant draws the cervix down by seizing the volsellum with his right hand. With his left hand he sponges the wound, or better yet, has directed against it from a short distance above, intermittent spurts of fluid from the irrigator.

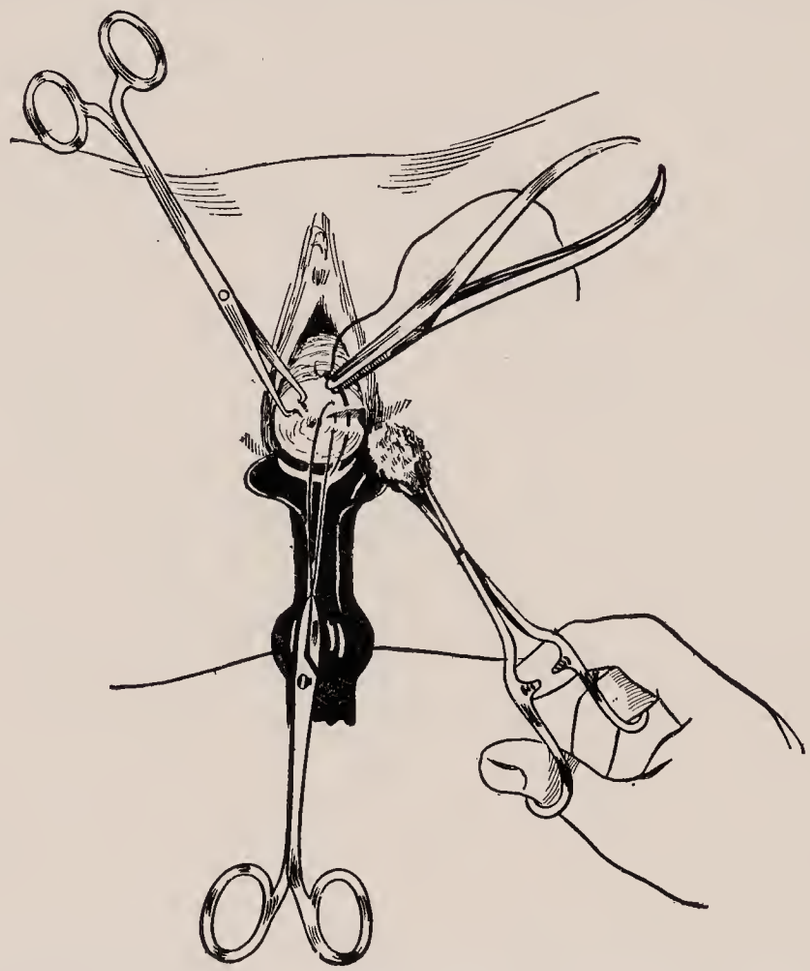


FIG. 92. Trachelorrhaphy. Assistant sponging wound and clamping sutures.

As the stitches are being drawn through, the assistant should exercise counterpressure against the cervix near the emerging needle point, by means of some stiff instrument, *e. g.*, a counterpresser, dressing forceps, curette or the flat end of a grooved director. The ends of each suture, unless secured at once, should be grasped in a hemostat, or lifted up in the assistant's right hand. When all are in place they are fed to the operator, one by one in regular order, to be

tied. Assistance at adaptation may be needed, as with other wounds. A uterine sound is to be handed next to test the patency of the cervical canal. Then the uterine gauze drain is passed.

VAGINAL HYSTERECTOMY.

The instruments to be laid out are: a weighted speculum or short perineal retractor; a pair of short, right-angled lateral retractors; a pair of long narrow retractors; two or more volsella; a catheter; a bladder sound; scalpels; blunt scissors, curved on the flat; long-handled sharp scissors, curved on the flat; aneurism needles, right and left; long hemostatic forceps; an assortment of strong, straight and curved "broad ligament clamps"; needle holder; medium-sized, half-curved needles; a few finer full-curved needles for use in case of injury to the bladder; several sponge handles; two mouse-tooth forceps. Several heavy catgut (No. 4 or No. 5) and heavy silk ligatures about sixteen inches long should be ready, and two sutures of No. 2 catgut may be prepared for closing the vaginal vault. The assistant's work will lie in the management of the retractors, in sponging and in handing and removing instruments. The perineal retractor is first handed and then a volsellum. After these the surgeon may desire a strip of gauze for the cervix and, probably, a second volsellum. If by depressing the cervix he indicates that he intends incising anteriorly first, he should be handed the bladder sound, which the assistant is to hold in position if used, and then the blunt scissors. The lateral retractors are now inserted if a nurse is at hand to help in holding the vagina open,—the assistant manipulating the right lateral retractor and the bladder sound, the nurse holding the perineal and the left retractor. When the bladder sound is no longer needed the assistant has his left hand free for sponging. The long artery clamps may be needed for bleeding in the vaginal vault. If the operator lifts up the cervix, and begins posteriorly instead of anteriorly, the sound will not be needed, of course.

When the cervix has been freed all around, a long narrow retractor should be handed for insertion between the bladder and uterus. This is to be drawn up strongly. Whether the surgeon will use clamps or ligatures, or both, in securing the broad ligaments he will have to indicate to the assistant. If he use ligatures, then when he draws the uterus to the left he should be provided with a ligature (catgut or silk, as he may desire) mounted in a right-handed aneurism needle, and *vice versa*. As the ligature pierces the broad ligament, the assistant should grasp and hold the loop with forceps until the operator, after withdrawing the carrier, relieves him of it. Usually three ligatures are inserted on each side, the broad ligament being cut and the uterus dragged down further after tying each pair. If clamps are used, one to three are needed on each side, the operator either replacing them with ligatures or leaving them in situ. When clamps are not left on, catgut sutures are used for closing, in part, the vaginal roof, the broad ligament pedicles, especially when tied with silk, being drawn out for inclusion in the stitches. A gauze drain is needed.

In an operation of this sort, through an aperture that is relatively small, the assistant will help most, not by trying to do much, but by endeavoring at all times to render necessary aid without obstructing the surgeon's manipulations. In retracting, sponging, etc., he should use that hand which will least interfere and should dispose his forearms with the same consideration.

DRAINAGE OF PELVIC ABSCESS, ETC.

Here are needed: bivalve, Sims, or weighted speculum, or vaginal retractors; volsellum; aspirating syringe and long, stout needle; [grooved director]; dressing forceps; long-handled sharp-pointed scissors, preferably curved (on the flat); gauze packings two inches wide; gauze for vaginal tamponade; specimen dish; pus basin; and irrigator. Two stout pieces of rubber tubing about ten inches long should be prepared, fenestræ being cut near the tip. A T tube is

sometimes used. This is made by stitching the end of a long piece of tubing around an opening made in the center of one side of a second piece two inches long. This short arm is to be doubled up in the dressing forceps when the tube is inserted.

The speculum or retractors and volsellum are first handed, then the aspirator [and after this the grooved director] and

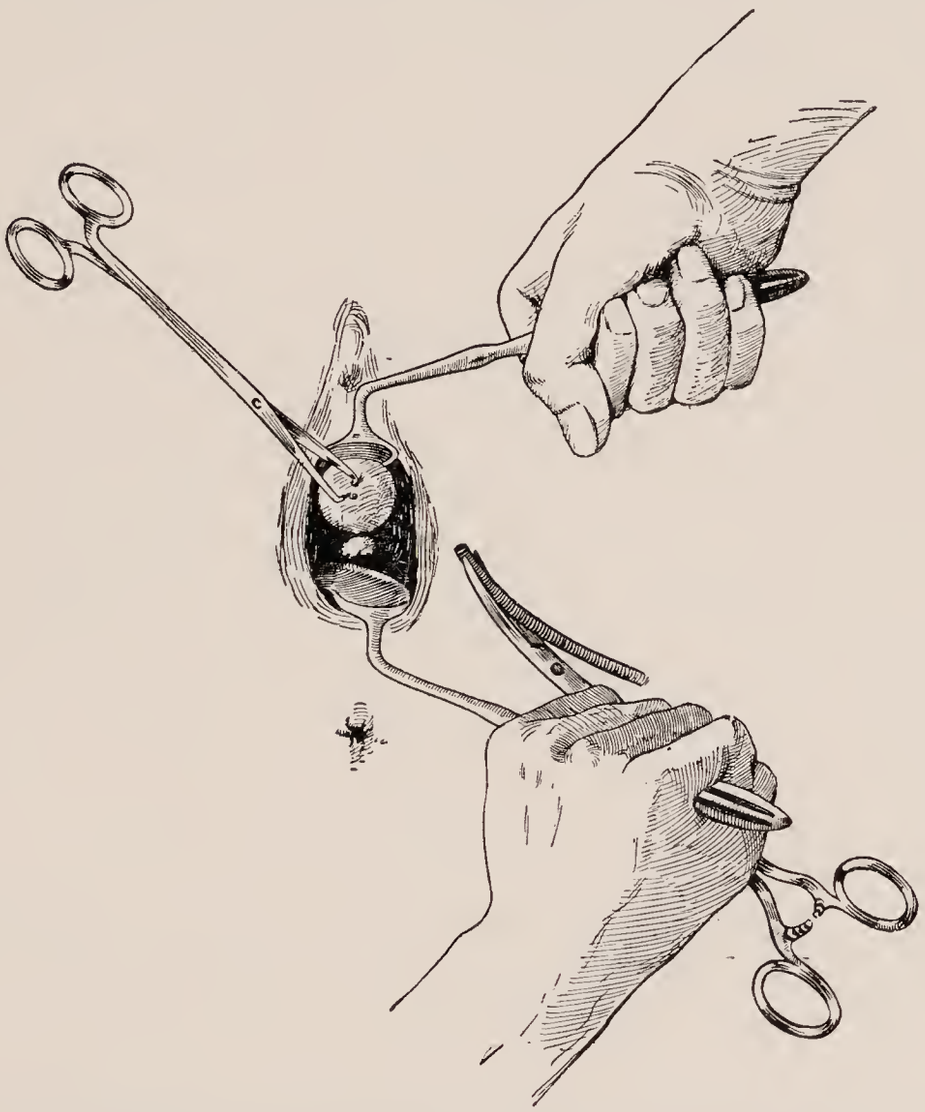


FIG. 93. Drainage of pelvic abscess. Showing manner of forcibly retracting vaginal walls, and method of inserting drainage tube in dressing forceps.

scissors. Dressing forceps may be desired to enlarge the opening, and a pus basin should be held to catch the evacuated fluid if large in amount. One or two drainage tubes or a T tube are then handed to the operator, grasped by the end in the tips of long-bladed dressing forceps, as shown in

figure 93. Here the author's cervix-elevating attachment to the anterior vaginal retractor (appendix, fig. 109), may be substituted for the volsellum to better put the posterior fornix on the stretch, and open the wound for the easy insertion of the drain. The irrigating tip is attached to the inserted tube in order to wash out the cavity. A strip of gauze may be desired in place of, or in addition to, the tubing. The latter is cut off just beyond the vulva, and a piece of gauze is inserted into the vagina.

PLASTIC OPERATIONS UPON THE VAGINA AND PERINEUM.

These require: volsella; two "tissue" or mouse-tooth forceps; full-bellied scalpels; long-handled, sharp-pointed scissors curved on the flat; artery forceps; sponge handles; suturing instruments and materials; irrigator to keep the field free of blood by means of intermittent jets of a small stream of fluid, directed from above. For the vagina there should be prepared long (continuous) sutures of silk or, more often, of No. 1 chromicized catgut in medium-sized, sharp, stout, half-curved needles. A Peaslee or other "handled needle" (appendix, fig. 28), is often used for passing the silkworm-gut, silk, silver wire or horsehair perineal sutures.

ANTERIOR COLPORRHAPHY FOR CYSTOCELE.

The assistant's arrangement and preparation of the tables, the patient and himself are as described for curettage. The vulva and perineum should be shaved, however.

In addition to the instruments above mentioned, there may be needed a weighted speculum or posterior vaginal tractor, a bladder sound and a catheter. The speculum is handed first, although, since the tissues are relaxed and easily exposed, it is not always needed. Then there are passed to the operator, one after the other, four volsella with which to seize the anterior vaginal wall at points on the circumference of what is to be the area of denudation. In order to outline and then remove this area it must be evenly exposed by

traction on the volsella—or on guy sutures that may be used as substitutes for the volsella. A second assistant (nurse) is therefore very useful here. Facing the operator, and standing at his left, she holds steadily the uppermost volsellum vertically (with her left hand) and the one fastened on the left side horizontally (with her right hand). The assistant draws upon the volsellum at the right side with his left hand —the right hand being thus left free for the manipulation of mouse-tooth forceps. The fourth, lowermost, volsellum

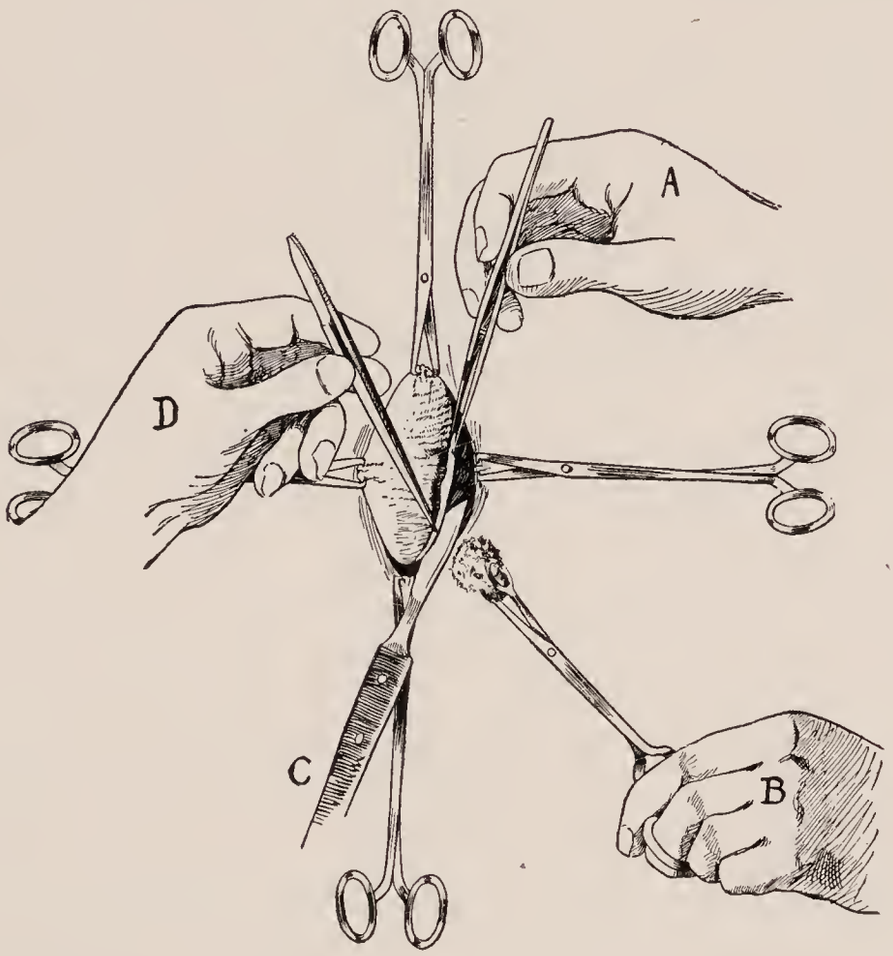


FIG. 94. Dissection of cystocele flap. A, assistant's right hand; B, assistant's left hand; C, surgeon's right hand; D, surgeon's left hand. Volsella being held here by other assistants.

exercises traction by gravity as, in its place, a guy suture may be made to do by attaching a heavy clamp to its ends.

Lacking a second helper, the outlining and denudation must be done alternately on one side and the other while the assistant holds the uppermost volsellum and the irrigator tip

with his right hand, and first one and then the other lateral volsellum with his left hand (taking care to keep the left forearm out of the operator's way).

It is important that traction upon the volsella should be made symmetrically, to avoid distortion of the denudation area, and that the volsella should be held flat, *i. e.*, in such a manner as not to twist the tissues.

Mouse-tooth or "tissue" forceps is handed to the surgeon and, according to his preference, scalpel or scissors. If the assistant have a hand free he too takes a pair of mouse-tooth forceps and with this aids in raising the flap that is being dissected up. That is to say, he applies the forceps at the flap edge, near the point seized by the operator, and moves the instrument when the latter does his, as the dissection proceeds from one place to another. In order that his hand may not obstruct the field, the assistant should apply his forceps at a point above that seized by the surgeon when the right side is being denuded (see figure 94), while when the dissection is on the left side he applies his forceps at a point below the surgeon's and may shift it to his left hand to accomplish this conveniently. He should raise the flap evenly with the operator to help him to avoid "buttonholing" it, and if he observes an island of mucosa that has not been removed he may indicate it to the operator by lifting it up with his forceps. Bleeding vessels should be seized with hemostats, each to be left attached until it is reached by sutures—ligatures being undesirable and only occasionally necessary.

The entire area denuded and irrigated with hot sublimate or other solution, traction on the laterally placed volsella, continued symmetrically to prevent infolding and distortion, is relaxed in order to accommodate the introduction of sutures. These are ordinarily applied in tiers—unless the denuded surface is quite narrow—and a single strand of chromicized catgut, if sufficiently long, will suffice for the purpose. Introduced and tied at the upper angle, the assistant seizes the short, free end of the gut with his right hand, and removes the volsellum at that point. Each loop of the

continuous suture is in turn seized and lifted up between the thumb and forefinger of the assistant's right hand, and is released only as the next loop is drawn through (figure 95). As each loop is being drawn the centre of the tissue it includes should be pressed in with forceps in the assistant's left hand, to facilitate adaptation. The same manipulations are repeated as the second tier is being sewed, the assistant's

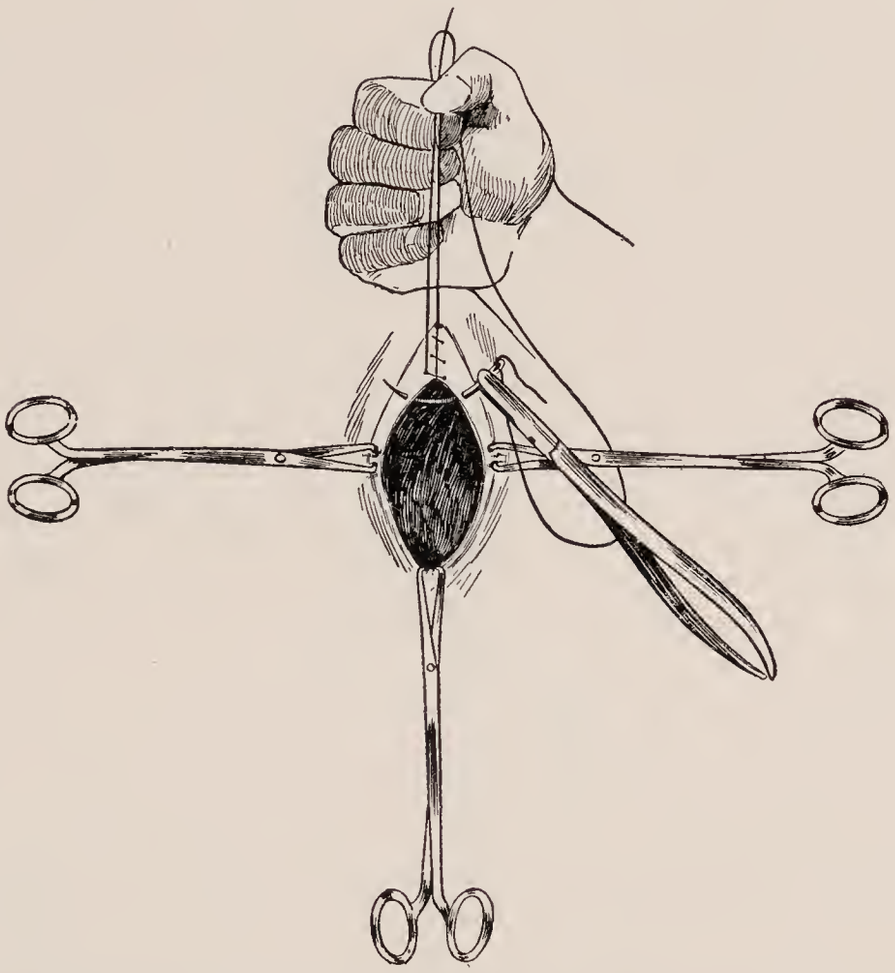


FIG. 95. Holding loops of suture in anterior colporrhaphy. Volsella being held by nurse.

left hand holding the suture taut if it is introduced from below upwards. With the last tier (interrupted or continuous) mouse-tooth forceps are manipulated, as in other wounds, to secure accurate coaptation. As in the dissecting, so during the suturing, intermittent irrigation may be employed to keep the field clean.

POSTERIOR COLPORRHAPHY; PERINEORRHAPHY.

In addition to the other preparations of the field, the rectum should be cleansed.

There are handed to the operator three volsella (or traction sutures). That one fastened to the center of the posterior vaginal wall is to be drawn upon vertically towards the urethra, those applied laterally at the margin of the vulva are

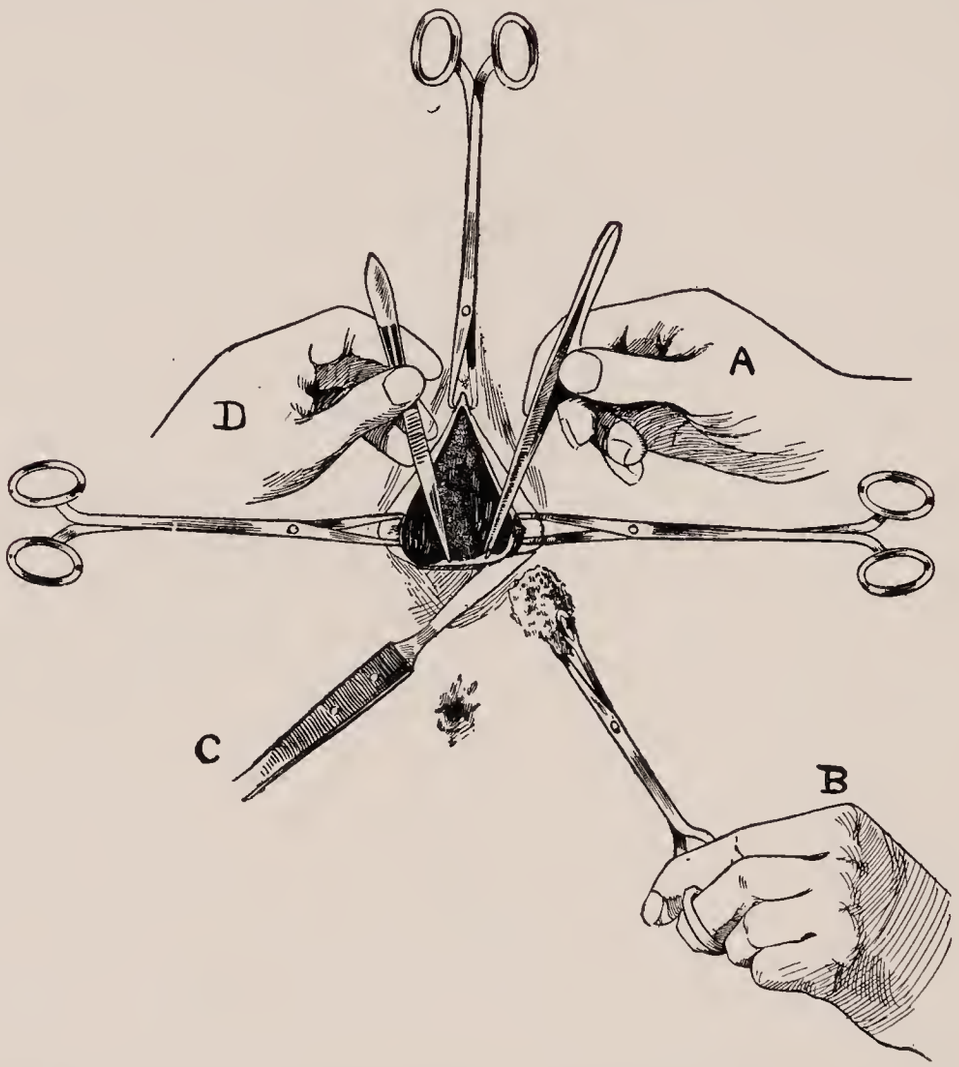


FIG. 96. Dissection of rectocele flap. A, assistant's right hand; B, assistant's left hand; C, surgeon's right hand; D, surgeon's left hand.

to be drawn apart horizontally—thus exposing and stretching out the triangular area to be denuded. If a nurse is at hand she is to hold the volsella or traction sutures at the apex and left extremity of the base of the triangle, respectively; while the assistant holds the volsellum at the right side of the

vulva. If no second helper is present, the assistant must manipulate the volsella himself, two at a time; while the operator dissects the area between them. The base line of the triangle must be put well on the stretch while it is being marked out with scalpel or scissors. Similarly the apex of the triangle must be drawn well up and steadied in the median line, both for the outlining of the sides of the area and for the subsequent dissection and suturing.

The assistant's technics in these procedures are essentially

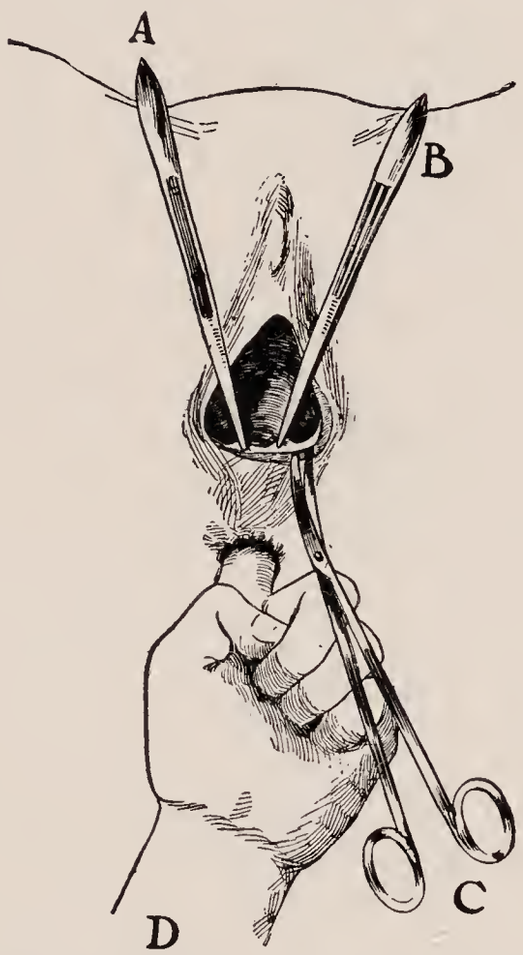


FIG. 97. Dissection of rectocele flap. A, assistant's right hand; B, assistant's left hand; C, surgeon's right hand; D, surgeon's left hand, index finger of which pushes up perineum through rectum.

as described for anterior colporrhaphy *(q. v.)*. Thus, with mouse-tooth forceps he lifts up an edge of the flap near the point seized by the operator, beginning at the base line, and moves his forceps with the surgeon's. In dissecting up the base of the triangle the assistant's forceps is applied

to the right of the surgeon's. As in anterior colporrhaphy it is applied above the operator's when the right side is being detached, below it when the left side is dissected. Bloodvessels exposed beneath the flap should be clamped before they are cut, if possible.

Some operators perform the entire denudation with the left index finger in the rectum. The assistant must then manipulate both the tissue forceps, thus preparing area after



FIG. 98. Posterior colporrhaphy. Assistant's right hand catching up the loop of suture to maintain apposition of edges.

area, in regular order, for dissection. He applies the forceps at the base line first, beginning at the right, and then lifts the flap up on the other sides, working towards the center of the triangle. Even traction is essential to prevent buttonholing, as is also elevation of the edge of the flap in such a manner that the tissue beneath is in view of the operator. When the denudation is performed in strips, with scissors,

it is important for the assistant to seize each successive portion of the mucosa in order that no undenuded island is overlooked.

The assistant's manipulations during the introduction of the tier sutures within the vagina are sufficiently described under anterior colporrhaphy. As the last tier approaches the vulva the traction strand at the apex is to be cut off and the vaginal floor dropped back.

The services of the assistant in the treatment of the perineal surface depend in part upon the suture method adopted and in part upon the extent of the perineal injury. If the perineal wound is short and superficial there may be required only two or three interrupted stitches of silk or No. 2 catgut, to be mounted in medium-sized full-curved needles.

If there has been a tear into or through the sphincter ani or even to a considerable depth into only the other muscles, the assistant should not hand the other perineal sutures until these structures have been repaired. If the torn muscle edges have not previously been sufficiently exposed and "freshened," forceps and sharp-pointed curved scissors, or scalpel, are now provided and the wound is held widely open. Interrupted sutures of No. 2 chromicized gut in small half-curved needles are required for the rectal mucous membrane, the sphincter and the levator ani et vaginæ. The assistant helps in lifting the ends of these tissues into the path of the needle, and cuts each suture short after it is tied.

If the muscular injury has not been deep, the through and through perineal sutures may be handed at once. These are usually of silkworm-gut, silver wire or stout silk. Large full-curved needles may be used, or the operator may prefer a Peaslee perineal needle. In either case the assistant should steady the tissues with his hands as they are being transfixed, the surgeon's left hand being occupied in picking up the deeper structures into the path of the needle. The Peaslee needle is handed to the surgeon unthreaded. As its point appears on the left side of the perineum each time that it is thrust through, the assistant passes a suture (*e. g.*, of silkworm-gut) through its eye, to be drawn back through the

wound (figure 99). When coarse silver wire is used, there is first inserted in the needle a silk carrying loop, by means of which the wire, bent sharply upon itself at the end, is dragged through. The corresponding ends of each perineal suture are to be clamped in hemostats until all are in place. As each is tied, or secured with button and shot, the assistant

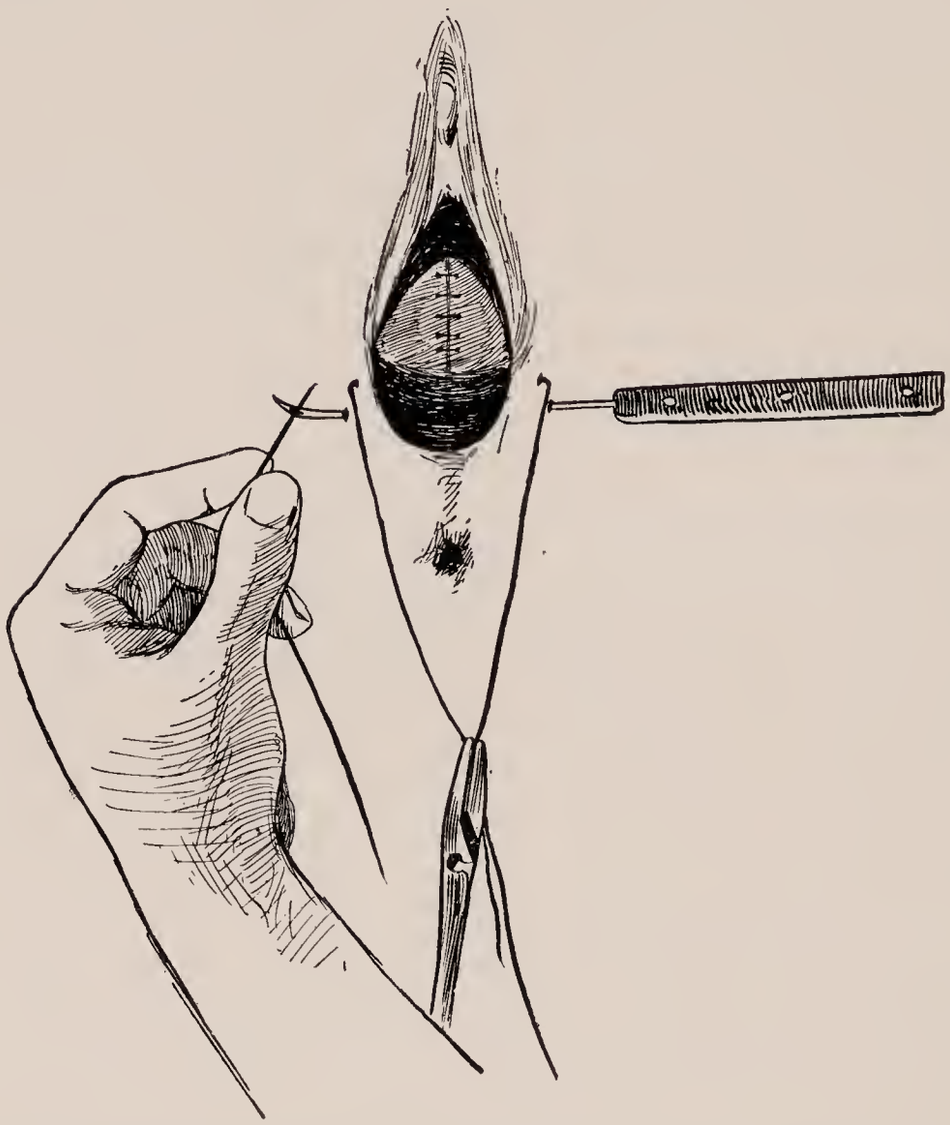


FIG. 99. Insertion of perineal sutures. With left hand assistant is passing suture strand through eye of Peaslee needle.

coaptates the skin edges. Intermediate sutures of catgut may be needed to secure satisfactory skin approximation. An antiseptic powder (*e. g.*, iodoform) is usually dusted on the wound. A strip of gauze is laid in the vagina, and a gauze pad is secured over the perineum with a T binder.

CHAPTER XXIII.

RECTAL OPERATIONS.

Position of the Patient. For purposes of examination, the assistant should place the patient, according to the surgeon's choice, in either the lithotomy or the knee-chest position, in Sims' position with the upper natis retracted by the assistant's or the patient's hand (figure 100), or upon the belly with a pillow under the hypogastrium and the lower extremities hanging over the end of the table and supported by the assistant. All of these postures are employed, more or less, for operations also, but,—except for resection of the rectum

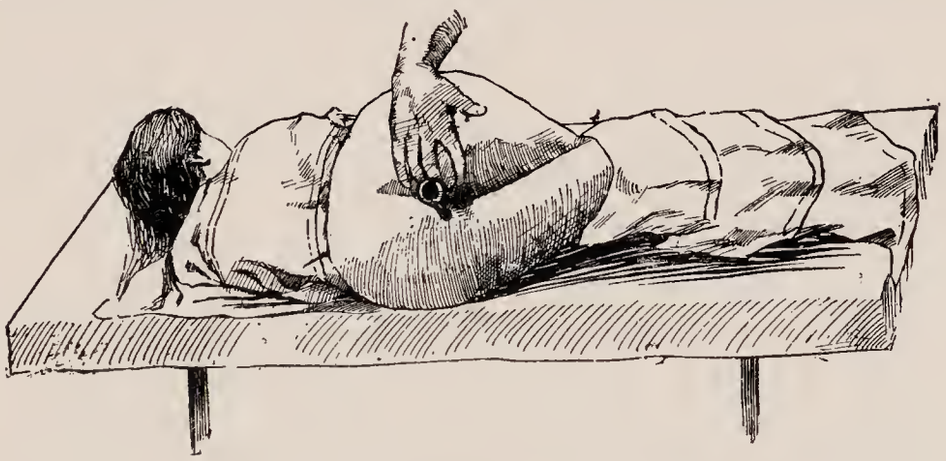


FIG. 100. Showing use of Sims' position for rectal examination.

by the sacral route, where there is used the lateral or the prone position or the dorsal posture with a pillow under the lumbar spine, and the pelvis lifted above and beyond the table,—there is most often employed the lithotomy position. The arrangement of the operating and accessory tables and the disposition of the patient, the surgeon and the assistant are then just as described for perineal and vaginal operations.

Preparation of the Field. The perineum should be shaved. In order next to cleanse the rectum the assistant

may find it necessary to first stretch the sphincter ani to permit the introduction of the sponge. The patient must be "well under" the anesthetic, and will ordinarily groan during the dilating process unless the narcosis is profound. The thumbs, anointed with soap or vaselin, and with their dorsal surfaces apposed, are introduced into the rectum, as far as, or just beyond, the knuckles. With the other fingers, purchase may be secured on the buttocks. The thumbs are then drawn slowly and steadily apart until the sphincter is felt to "give" and the anus gapes. This should be accomplished without any laceration of the mucosa. After rectal operations, more especially after operations involving dilatation of

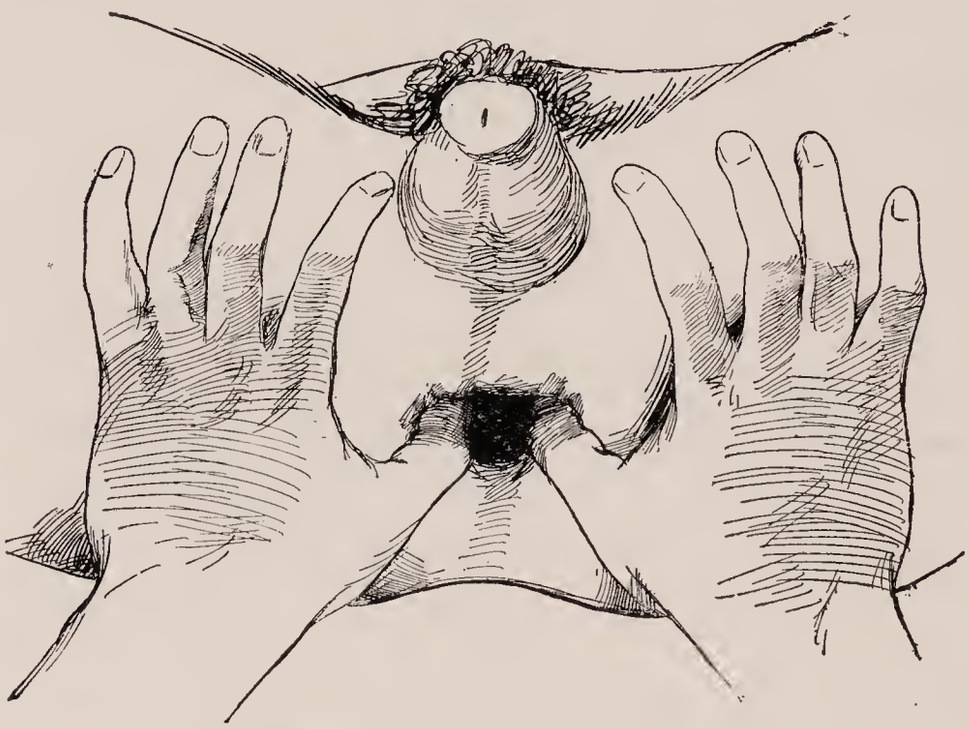


FIG. 101. Manner of stretching the sphincter ani.

the sphincter, it is often the case that the patient is unable to void urine voluntarily for a day or more. This is particularly apt to occur if the stretching has been done in a vertical direction, *i. e.*, towards the urethra and towards the coccyx. It is wise, therefore, for the assistant to stretch only laterally, *i. e.*, to draw his thumbs towards the tubera ischii.

The rectum is then swabbed out with soap and water by means of a sponge or cotton mop fastened in a sponge carrier. With the anus held open, the soapsuds are next

washed out of the bowel by an irrigation with warm sublimate solution, 1-5000. Only a small amount of the solution should be used, for if any be retained in the gut it may be expelled later during the operation, to the annoyance of the operator. To prevent any such expulsion of retained fluid or of feces, and also for use as a tractor to expose internal hemorrhoids, there may be introduced into the rectum—either by the assistant after he has completed the preparation of the field by disinfecting the perineum, or by the surgeon at the beginning of the operation—a "*sponge on a string.*" This is made by attaching a double strand of heavy silk or catgut to the center of a gauze- or sea-sponge, either by transfixion or, better, by means of a double knot or of a clove-hitch (see figure 37). After cleansing the field, the assistant disinfects his hands and slips a gown over his rubber apron, then spreads towels over the end of the table and on the patient's thighs, and taking his seat on the operator's right, lays a towel across the surgeon's lap and another upon his own.

The Rectal Dressing. After the operation for hemorrhoids, polypus, prolapus, etc., some surgeons dust the

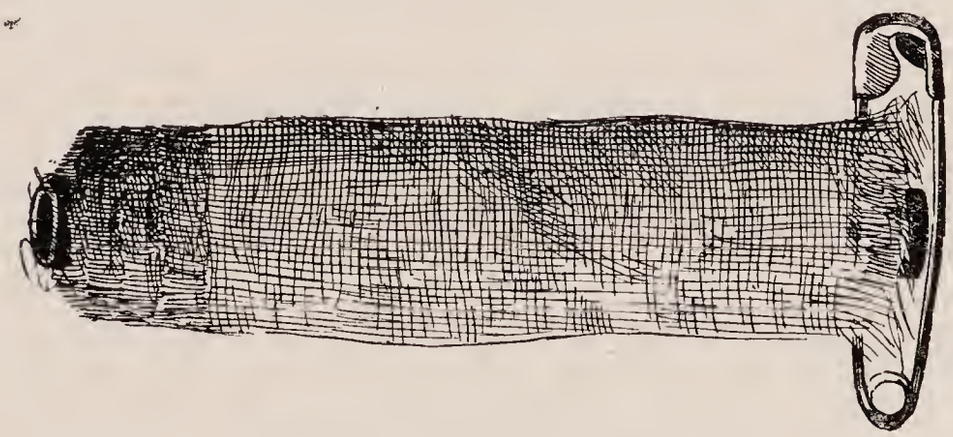


FIG. 102. "Tampon canula."

wound with iodoform and introduce simply an anodyne suppository, others employ a simple strip of gauze, while still others pass into the bowel a "tampon canula." This latter has the advantages of preventing oozing of blood by gentle pressure against the wound, of allowing any considerable hemorrhage to show itself in the outer dressings, and of

making painless the escape of flatus and the introduction of enemata. It should be prepared in advance by the assistant, and may be made of any size, but is ordinarily about three inches long. A piece of stiff rubber tubing of that length is smeared with vaselin and wrapped about with several layers of iodoformized gauze of the same width. Vaselin is rubbed in over each turn of the gauze. One end of the tampon is then trimmed in the form of a truncated cone, as shown in

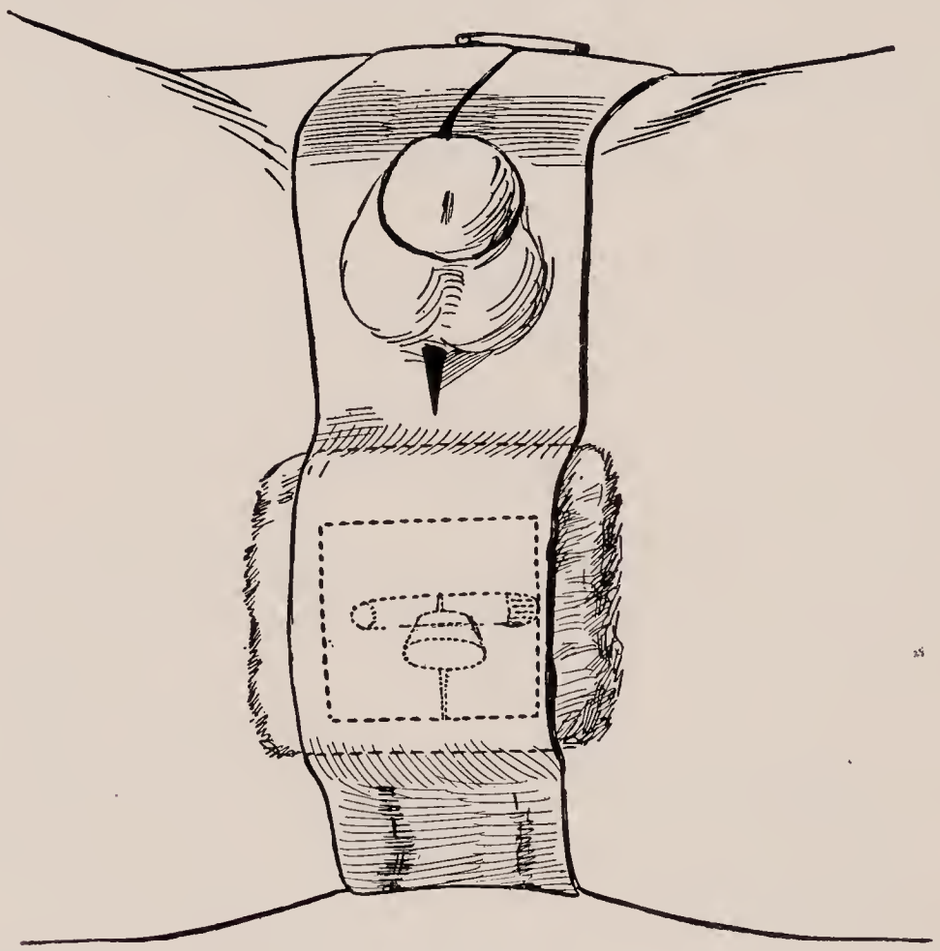


FIG. 103. Rectal dressings—tampon canula, split compress, gauze pad, T binder.

the illustration, the surface is smoothed with a final application of vaselin, and the distal end is transfixed with a large safety-pin to prevent the canula from slipping entirely into the bowel.

The external dressing consists of a split compress when the "tampon canula" is employed, of one or more pads of gauze and a T binder, as indicated in figure 103. The gauze

may be pinned to the binder to prevent slipping of the dressing.

RADICAL OPERATION FOR HEMORRHOIDS.

There should be ready: rectal speculum (*e. g.*, Sims' bivalve), pile clamp (appendix, fig. 115), Paquelin cautery, two mouse-tooth forceps, a few artery forceps, [dressing

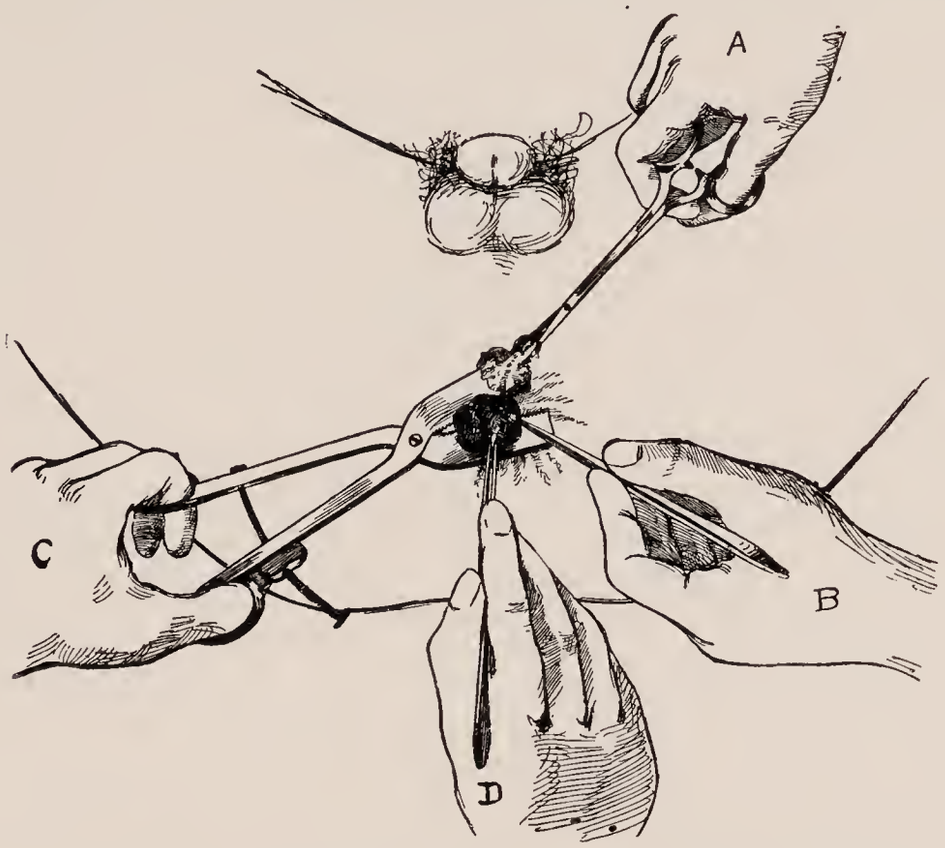


FIG. 104. Clamp and cautery operation. A, assistant's right hand; B, assistant's left hand; C, surgeon's left hand; D, surgeon's right hand.

forceps], scissors curved on the flat, [a scalpel], needles and needle holder for suturing operations, sponges, a few sponge handles, No. 2 catgut ligatures, other ligature and suture material as described below, "sponge on a string," iodoform duster, tampon canula, split compress, gauze pads and binder. If there is no second assistant, these articles may all be arranged on a low table within easy reach.

Clamp and Cautery Operation. (Smith's.) The "sponge on a string" having been inserted into the rectum, the assistant places in the operator's lap the pile clamp, curved scis-

sors, and a pair of mouse-tooth forceps, and a pair of forceps in his own lap. By gentle traction upon the string, if this be necessary, or by everting the mucous membrane with his fingers on each side of the anus, the assistant exposes the hemorrhoids. The surgeon having lifted a pile at one point, the assistant seizes it near the further extremity in such a manner that the clamp can be properly applied beneath the forceps and in the direction of the axis of the rectum (figure 104). The blades of the clamp closed, the assistant relin-

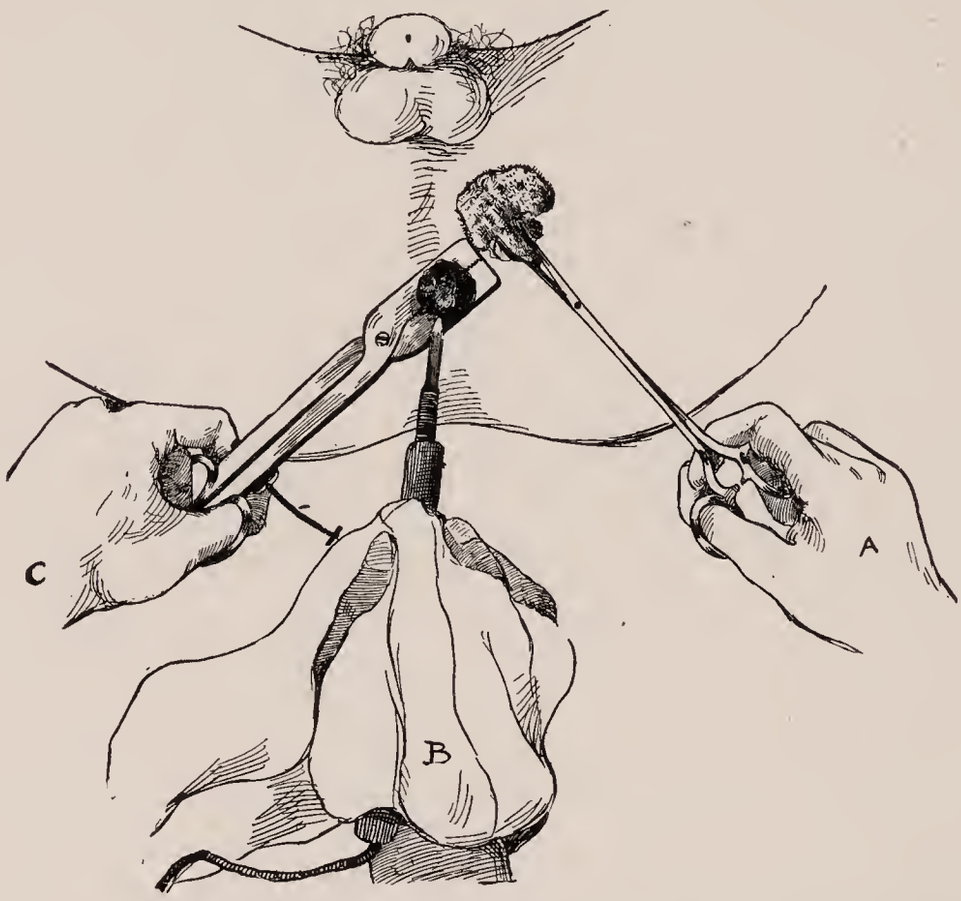


FIG. 105. Clamp and cautery operation. A, assistant's right hand; B, surgeon's right hand; C, surgeon's left hand.

quishes his forceps and screws tight the fixation nut of the clamp. Then he wipes the pile dry with a mounted sponge, and rests the latter just beyond the end of the clamp to prevent damage by slipping of the cautery. If the surgeon does not remove the hemorrhoid with scissors (and *then* sear the stump) a towel is placed over his right hand in which to receive at once the handle of the Paquelin cautery. The

platinum should be kept at a cherry red heat only—*i. e.*, not "white hot," yet hot enough to thoroughly sear the pile stump without sticking in its passage across it.

The cauterization completed, the assistant sponges charred bits from the surface of the clamp and unscrews the nut to release it. When the other piles have been similarly treated, he *gently* withdraws the sponge tampon from the rectum and again gently everts the mucous membrane that it may receive a dusting of iodoform crystals. After the iodoform box there should be handed the tampon canula [or gauze drain and a probe], split compress, gauze pads and T binder, in the order named.

Clamp and Suture Operation. (Thelwell Thomas.) After each hemorrhoid is clamped and cut off, the assistant hands to the surgeon a twelve-inch strand of No. 2 catgut, on each end of which is a straight needle, and with his left hand relieves the operator of the clamp while the sutures are passed from side to side and knotted. Hemostats and ligatures are occasionally needed also.

Crushing Operation. The assistant observes the same technic as in the previous methods, the "screw-crusher" being used instead of the clamp. No cautery is necessary, the pile being amputated with scissors or scalpel just before the crusher is released.

Ligature Operation. (Allingham.) As in the other methods, the assistant aids in elevating each pile with mouse-tooth, hemostatic or volsellum forceps, while the mucosa near the base is circumcised with curved scissors [or scalpel]. The assistant then hands a No. 3 catgut or stout silk ligature, and drags upon the pile with both the forceps while the surgeon ties the hemorrhoid and cuts it off. If it is large enough to need ligating in segments, a ligature of double length is to be threaded on a large surgical needle, or passed through a Peaslee needle, with either of which the centre of the pile is transfixed.

Excision of the Pile-Bearing Area (Whitehead's Operation.) If after stretching the sphincter there is not sufficient prolapse, with the spread fingers of the left hand the

assistant, by pressure on each side of the anus, causes the hemorrhoidal area to protrude. With forceps in the right hand he aids the surgeon in picking up the mucous membrane near the skin border, in order that it may be separated here with blunt scissors and dissected up. The assistant's technics are much the same as in assisting at vaginal plastic operations. Spurting vessels must be clamped, and tied or twisted. After each portion of the dissected cuff of mucous membrane is cut away, a silk suture will be needed to attach the corresponding cut edge of mucosa to the skin, the assistant helping in the adaptation with his mouse-tooth forceps. The dressing is the same as in the other methods of operating.

INTERNAL DIVISION OF STRICTURE OF THE RECTUM.

Here are needed: speculum; [straight steel sound]; scalpel; stout, long-bladed, probe-pointed bistoury; long curved and straight scissors; long dressing forceps; slender clamps; sponges in carriers; ligatures; an assortment of Wales' rectal bougies (appendix, fig. 116); drainage tubing; and gauze. The diseased area should be kept well exposed, well lighted and sponged dry. After the stricture is divided, successively larger bougies are needed. The internal dressing consists of a large tampon canula. If, however, there is much hemorrhage from vessels that cannot be ligated, there should be quickly prepared, instead, a "petticoated tube" (canule à chemise). This is made by stitching an end of a piece of stout rubber tubing in an opening made in the center of a large square of gauze. After it is passed, like a closed umbrella, into the rectum, long strips of gauze are handed to the surgeon with which to pack tight the space between the tube and the square of gauze, as in the manner of filling a "Mikulicz bag."

FISTULA IN ANO.

The instruments required are: speculum; slender, flexible probe; stout probe; grooved director; narrow scalpel; straight and curved scissors; mouse-tooth forceps; sharp re-

tractors; Volkmann spoons; sponge carriers; hemostats; [needles; needle holder; and sutures]. Peroxid of hydrogen or a colored solution (*e. g.*, of methylene blue) is sometimes used, as an injection, to aid in demonstrating all branching sinuses. The assistant's duty is to keep the



FIG. 106. "Canule à chemise." (Petticoated tube.)

wound well retracted and dry, and from time to time to hold a probe or director in the fistulous tract. The dressing consists, usually, in a gauze packing and compress, with or without a tampon canula.

CHAPTER XXIV.

OPERATIONS UPON THE EXTREMITIES.

AMPUTATIONS.

For Major Amputations the assistant should have ready: one or two large scalpels; straight and curved scissors; two mouse-tooth forceps; four sharp-pronged retractors; one dozen artery forceps; a stout probe; dressing forceps; full-curved and half-curved needles; needle holder; amputating knife; double-edged interosseous knife* ("catlin") for amputations through the forearm or leg; raspatory; periosteal elevator; large flat saw; Gigli wire saw; [metacarpal saw]; [lion-jaw bone forceps]; Liston's or other bone-cutting forceps; [rongeur]; anatomical forceps; tourniquet; [Horsley's bone wax]; "cloth retractor"; ligatures and sutures; irrigating salt solution; drainage tubing; sterile rubber tissue; six or eight sea-sponges in a basin of hot sublimate solution; an abundance of sterile gauze; absorbent cotton; several four-inch bandages; [starch bandages]; splints; and the usual supply of towels, sheets and other accessories. The paraphernalia for intravenous infusion should also be at hand as for any operation that may entail great shock or loss of blood.

The catlin is not essential, and may be replaced by the amputating knife itself, if of narrow blade, or by a scalpel; the saw may be omitted for disarticulations; while the special transfixion pins must be included with the other instruments in preparing for an amputation at the hip or shoulder by Wyeth's method.

The Tourniquet. While Petit's apparatus,—consisting of a stout strap with pad and buckle and two plates to be separ-

* See Appendix 2, pages 339 and 346.

ated by a screw,—and other older forms are still occasionally used, bandages, tubing or bands of rubber are most employed for constricting the limb. They are to be sterilized in boiling water, after the assistant has assured himself that they are strong and sound. This last is important, since rubber often submitted to heat, or not kept in air-tight containers between operations, is apt to prove rotten at the critical moment. For the shoulder or the upper part of the thigh there should be

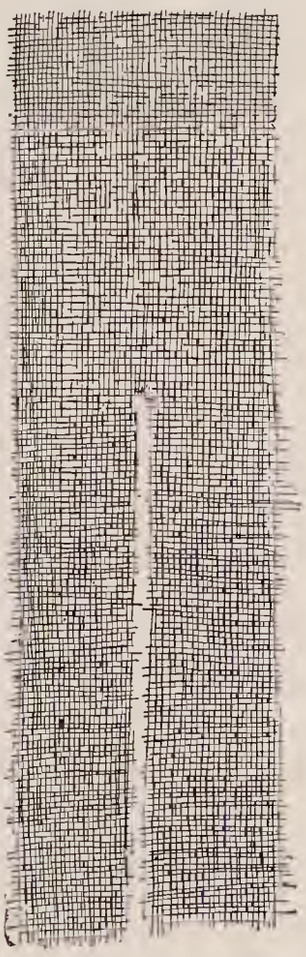


FIG. 107. Two-tailed cloth retractor.

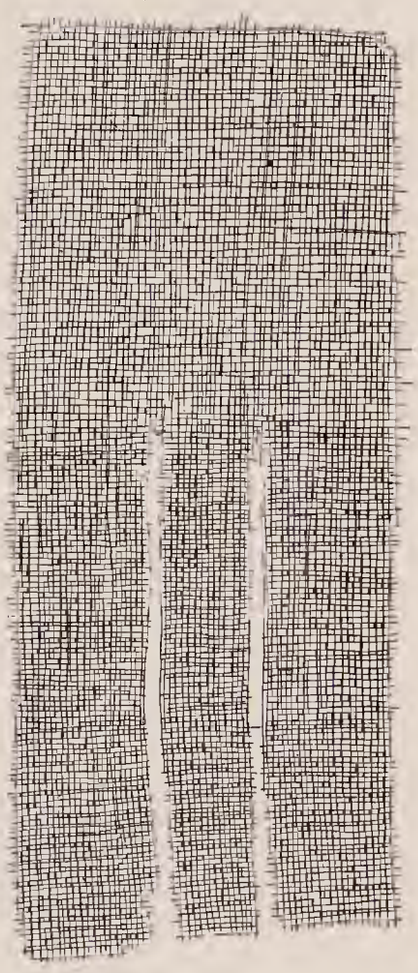


FIG. 108. Three-tailed cloth retractor.

ready Esmarch's constrictor,—consisting of a flat rubber band with a hook at one end and a chain at the other,—or a piece of stout, soft (black) rubber tubing two feet long; while for constriction at other points, except the digits, the Martin rubber bandage should be prepared.

The Cloth Retractor is designed to hold the soft parts out of the way while the bone is being sawn. It consists of a

sterile towel, or of a piece of unbleached muslin or of several thicknesses of gauze, about two feet long and one foot wide, torn lengthwise half way into two or three tails. The two-tailed retractor is to be prepared for an amputation through the arm or thigh; while for an amputation through the forearm or leg a three-tailed retractor will be needed, the middle (narrow) tail passing through the interosseous space. After the retractor is split it should be rolled up until wanted.

Position of the Patient. When the amputation is through the upper extremity, the limb should be supported by a nurse or assistant at right angles to the body,—the axilla or the upper portion of the arm, according as the amputation is in the arm or forearm, being at the edge of the table. For amputations below the wrist, as for other operations on the hand, the assistant may support the extremity upon a board placed at right angles to the table and held in position by the weight of the patient's chest upon it.

For an amputation through the thigh or leg, the patient should be brought to the foot of the table so that more or less of the extremity, as the line of division indicates, projects beyond,—the opposite limb being supported upon a chair and covered with a sheet, as shown in figure 112.

Preparation of the Field. If the tissues to be removed are infected, they should be freely covered with gauze or towels, secured by a bandage, before any cleansing of the skin is attempted. In any case towels should be bandaged about the distal portion of the extremity up to a point six inches below the line of amputation. While the hand or foot is supported, the skin is then thoroughly disinfected. The assistant, having again disinfected his own hands, bandages fresh towels over the distal portion, and gives the extremity into the hands of a nurse who is "washed up," to hold for a few minutes in a vertical position in order to partially empty it of blood. This process may be much aided by "milking" the limb from the digits towards the trunk.

When it is important to save to the patient as much blood as possible, the assistant should apply a rubber bandage firmly to the elevated limb from the digits up as far as de-

sired (figure 109). The turns of this bandage should not reverse, nor scarcely overlap. The last few turns are made one directly over the other, and under the last turn the body of the bandage is slipped. The rest of the bandage is then unwound from the limb.

While the extremity is still elevated, the constrictor is next to be applied, either by the surgeon or by the assistant himself. If a rubber bandage has been used as above described, an Esmarch band is carried twice about the limb close above it and well on the stretch, and is secured by slip-

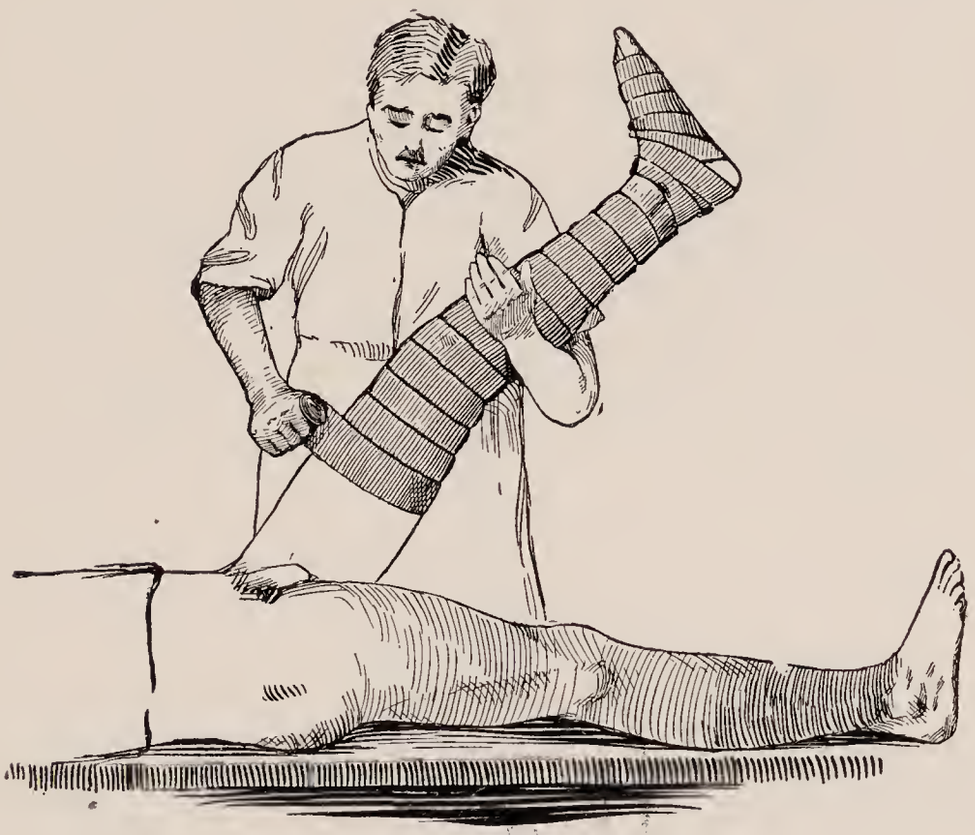


FIG. 109. Driving blood from the limb with rubber bandage.

ping the hook into a link of the chain; after which the bandage is removed. When a rubber bandage is used as the constrictor, several turns are made one directly over the other, and with the rubber well stretched; the body of the bandage is slipped under the last turn, the assistant taking care to remember whether it is inserted from below or from above, in order that it may easily be removed afterwards. In constricting the upper extremity, it is important that the band-

age should not be wound about the centre of the arm, for at that level it may cause paralysis of the musculo-spiral nerve by pressure against the humerus. Tubing used upon the thigh or upper arm, in the same manner as the Esmarch tourniquet, is wound about twice, and its ends are held tightly on the stretch and somewhat away from the body, while an assistant secures them by tying a piece of bandage around the crossing. The application of the older tourniquets needs no further description here than to say that they are intended to press directly and especially upon the main bloodvessels of the extremity. The constrictor in

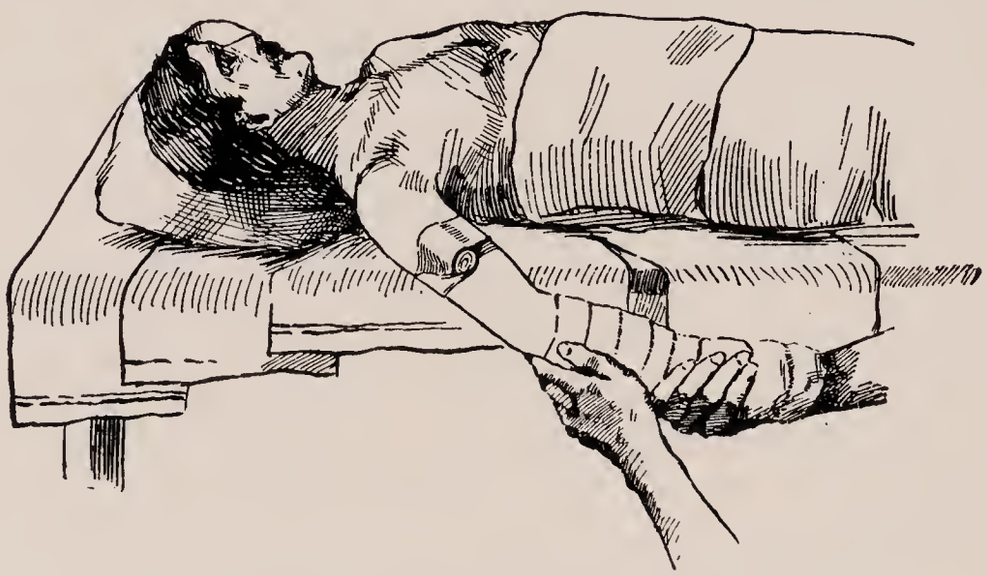


FIG. 110. Martin's rubber bandage applied to arm.

place, the limb is lowered *gently* to the horizontal, and towels are spread about the upper end.

The Operation. If there are two other helpers present, the assistant places himself opposite to the operator, who usually elects to stand so that his left side is towards the patient's trunk. If only a nurse is present to steady the distal portion of the extremity, the assistant manages the proximal portion, standing on the outer side of the thigh for an amputation of the lower extremity, on the side of the arm opposite to the operator for an amputation of the upper extremity. If no nurse be at hand the assistant must steady the limb alone by its distal or proximal portion, according as the amputation is above or below the midjoint. For amputations

at or below the wrist or ankle, the nurse manages the limb, while the assistant faces the operator.

Grasped firmly by the assistant above and by the nurse below, the limb is abducted sufficiently to allow the surgeon ample space, and is steadied at first horizontally, and later is depressed or elevated according as the tissues anterior, or those posterior, to the bone are being divided.

For a circular amputation, or an amputation with flaps cut by transfixion, the amputating knife is first provided; but in

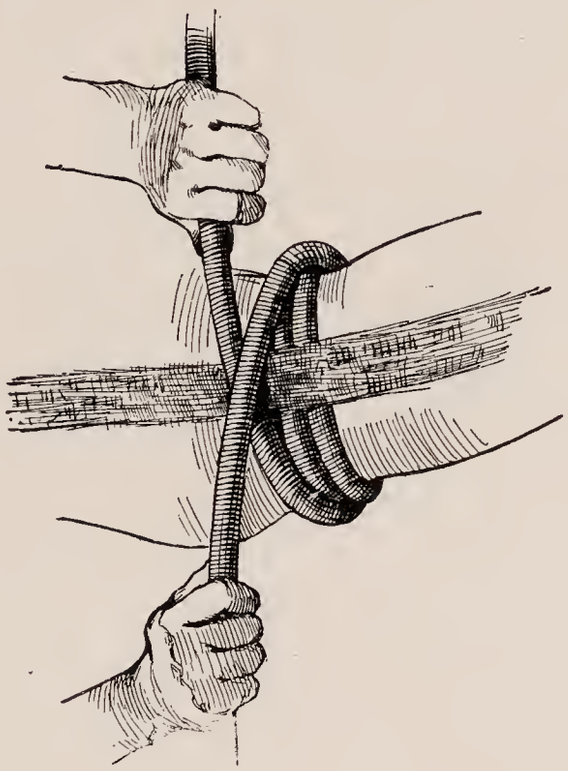


FIG. 111. Application of constrictor to thigh, and method of securing it with strip of bandage.

other cases the surgeon may desire to mark out the skin flaps with a scalpel before using the amputating knife. According as he has one or two hands to spare, the assistant now provides himself with one or two sharp-pronged retractors with which to lift up the skin- or skin and muscle-flaps to expose the tissues beneath, first at one place and then at another. This is especially necessary when the skin cuff is to be dissected up in circular amputations. Where, by reason

of the absence of a second helper (to hold the extremity), the assistant can spare but one hand for retracting, a retractor should also be given to the surgeon himself.

The muscles divided down to the bone, the surgeon is now relieved of the amputating knife and provided with the catlin for severing the interosseous tissues (amputation through the leg or forearm), and then a scalpel to circumcise the periosteum and [a raspatory and] an elevator with which to push that tissue back.

The two-tailed or three-tailed retractor being next applied, the assistant holds it drawn tightly over the proximal seg-

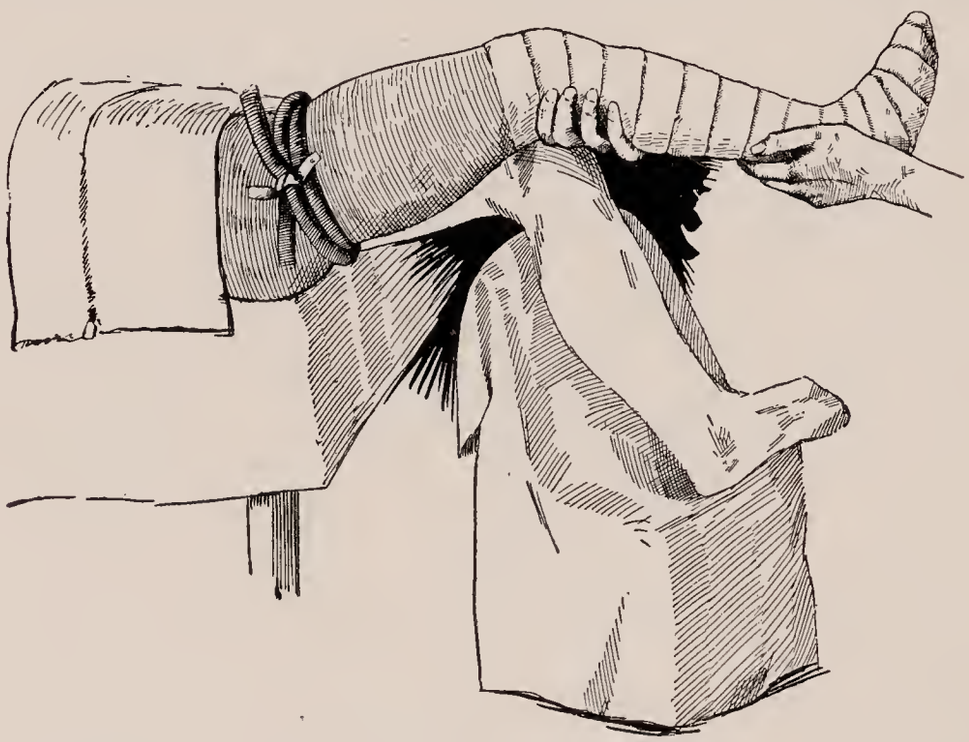


FIG. 112. Position of lower extremities in amputation of the thigh. Constrictor tied.

ment of the extremity in order to expose the bone to the saw (figure 113).

The assistant at one end, and the nurse at the other, must be careful during the sawing to hold the limb very steady, for uneven pressure upward may fracture the bone before it is entirely cut through, while pressure downward will make it bind upon the saw.

In order that the sawing may be easy, the assistant should drip water from an irrigator or a sponge upon the bone until

it is completely divided. Occasionally, when the Gigli wire saw is used, the operator requests the assistant to take one of the handles. In that case he need only bear in mind that the saw must not be bent acutely over the bone, but



FIG. 113. Bone exposed for sawing. Two-tailed cloth retractor drawn tightly on tissues above.

should be kept almost straight, for otherwise it is apt to bind or even break. If any fragment of bone project beyond the sawn surface, the bone forceps will be needed for its removal.

[When the amputation is by the osteoplastic method of Bier there will be needed a metacarpal or scroll saw, or Gigli wire saw in a scroll saw frame, with which to cut out the bone flap, and a few catgut stitches to secure its periosteal covering in place.]

The cloth retractors are now to be removed and the stump elevated so that the operator can seek the severed blood-vessels, to facilitate which over-hanging skin or muscle should be drawn away with sharp retractors. The larger vessels having been clamped with hemostats, the assistant

squeezes the stump so that the trickling of blood from the smaller vessels may indicate their location. Until these are secured blood should not be sponged from the cut surface. After the bloodvessels have been tied, forceps and scissors are handed to the operator to draw out and cut short the large nerve trunks.

The constrictor is now to be removed, by either the as-

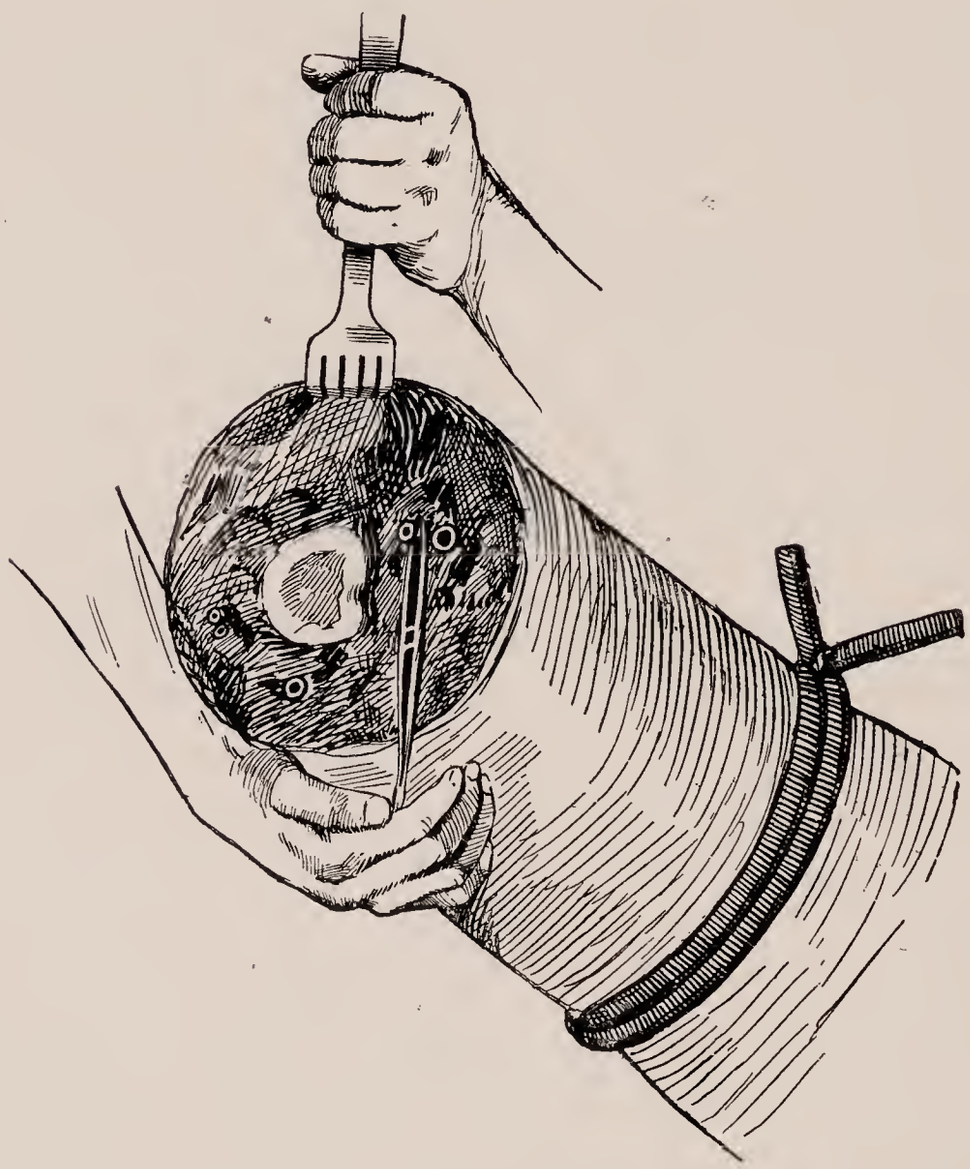


FIG. 114. Stump supported and bloodvessels exposed for clamping.

sistant or the nurse, as expediency may dictate. If the rubber tube constrictor has been used it is released by drawing tightly upon its free ends and cutting through the bandage

knot carefully with a knife. The pressure on the limb is diminished only gradually at first, so that any now bleeding large vessel can be secured, and then the tourniquet is removed altogether. After handling the constrictor the assistant should "wash up" before again helping at the wound.

When all visible vessels have been tied, a handful of sponges, wrung out of hot solution, should be laid upon the cut surface to check capillary oozing; while for bleeding from the bone itself a bit of Horsley's wax may be needed.

If the operator elects to stitch the muscles together over the bone there should be handed him a continuous suture of chromicized gut and a small drain consisting of a narrow wick of rubber tissue. Where, however, the skin only is to be united a fenestrated rubber drain should be provided, its projecting end to be transfixed with a safety pin. To unite the skin there will be needed plain or button sutures of silk or of silkworm-gut or strips of sterile adhesive plaster.

The Dressing consists of [a strip of gutta-percha over the wound, and on this] a compress of gauze, split to surround the tube, over which is arranged an abundance of loose gauze. A few gauze compresses are spread evenly over the loose pieces, and all are held in place by ample bandaging. If the leg or forearm has been amputated, the limb should be supported upon a well-padded splint in order to keep the knee or elbow, respectively, in extension. Bony prominences, *e. g.,* the knee, shoulder, iliac spines, etc., must be protected with cotton wool before bandaging over them. The stump should be held up while the patient is being carried to bed, and is then to be kept elevated by supporting it upon a pillow to which it may be pinned or bandaged.

Amputation of a Digit. Here are needed, for an "amputation in contiguity" (disarticulation): scalpel; mouse-tooth forceps; straight and curved scissors; two small sharp retractors; probe; [sharp spoon]; [bone-seizing ("lion jaw") forceps]; two hemostats; and suturing implements: while for an "amputation in continuity" (through a pha-

lanx) there are also needed a metacarpal or scroll saw and bone-cutting forceps.

If the amputation is at or close to the metacarpo-phalangeal or metatarso-phalangeal articulation a Martin rubber bandage should be applied to the forearm or leg, respectively. For an amputation beyond that point a piece of narrow soft rubber tubing or solid rubber may be used as a

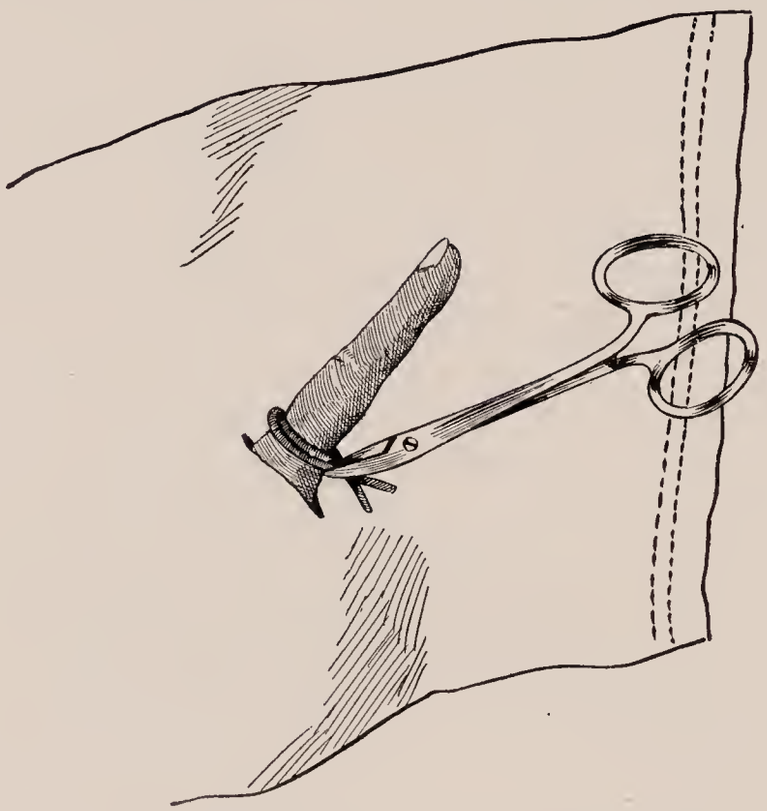


FIG. 115. Preparation of a finger for amputation.

constrictor about the base of the digit, being secured at its point of crossing with an artery forceps.

To isolate the field of operation the digit may be thrust through a small opening in a towel or compress of gauze. If the segment to be ablated is gangrenous or infected it should be wrapped in, or held in, a piece of gauze.

OSTEOTOMY FOR OSTEOMYELITIS.

The instruments needed are: scalpels; mouse-tooth and anatomical forceps; straight and curved scissors; probe; sharp retractors; periosteal elevator (appendix, fig. 77);

raspatory; dressing forceps; "sequestrum forceps"; hemostats; small sponge carriers; chisels and gouges; mallet; rongeurs; Volkmann bone curettes (sharp spoons, appendix, fig. 10); [bone drill (appendix, fig. 76)]; suturing implements; catgut sutures; a few ligatures. Bits of sea-sponge; a constrictor; an irrigator; and splints should also be ready.

The constrictor is applied, as for an amputation. Instruments are handed in the following order: scalpel, mouse-tooth forceps, sharp retractors, periosteal elevator or raspatory, chisel and mallet (see figures 38 and 39) and then, as

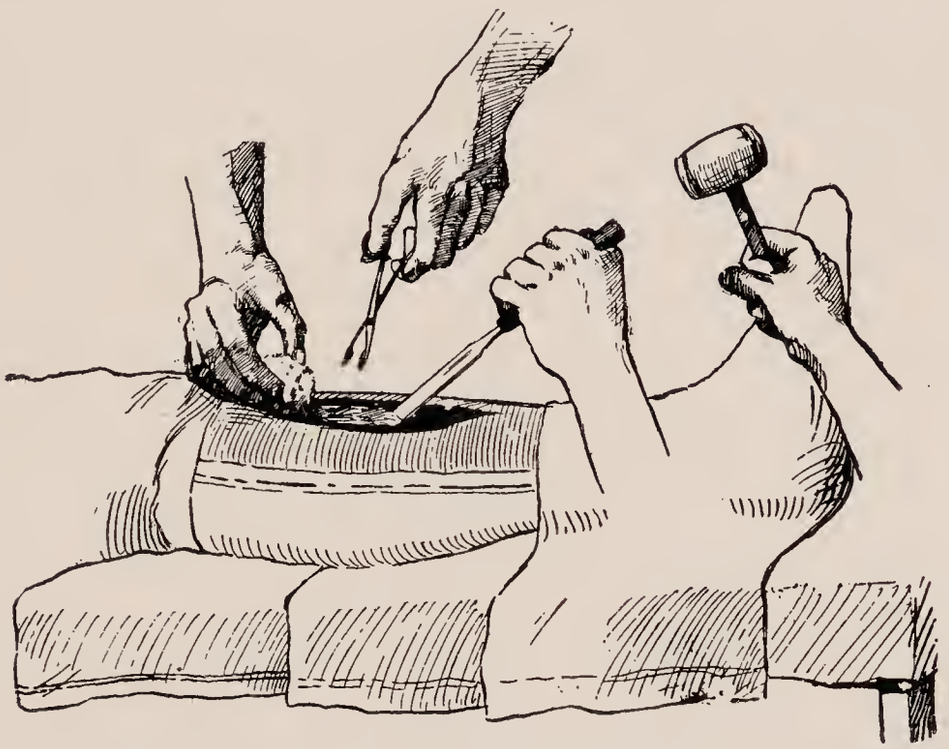


Fig. 116. Removing chips of bone and sponging pus, etc., in operation for osteomyelitis.

the case requires, gouges, curettes, sequestrum forceps, rongeurs or bone drill. The assistant's further duties consist chiefly in exposing the bone by retraction of the divided soft parts and, later, in keeping the bone cavity clear. For the latter purpose he should hold in one hand a dressing forceps to separate and remove each bone fragment as it is cut with the chisel, while with the other hand he mops out the cavity with small or large pieces of sponge, as described for mas-

toid operations. When the osteotomy is completed the bone is washed out with sublimate solution, 1-1000.

If the wound is left open the assistant provides gauze packings and an abundant absorbent dressing, [splint] and bandages. If a bone flap has been made (osteoplastic method), a gauze drain is needed, and sutures [for the periosteum and] for the skin; while if the cavity is allowed to fill up with blood, to be organized into bone (Schede method), no drain is used, but sutures are needed for the skin and a piece of rubber tissue is to be laid over the wound. Gauze compresses are then applied smoothly from the digits up, to be held by an even bandage. A starch bandage in which are incorporated strips of basswood veneer may be applied over all in place of using a posterior splint. The neighboring joints are to be immobilized in the dressing. The constrictor is not removed until the dressing is completed.

CHAPTER XXV.

SKIN-GRAFTING. SALINE INFUSIONS.

SKIN-GRAFTING (THIERSCH METHOD).

The following are needed: sharp (Volkmann) spoon; [McBurney skin-graft retractors]; skin-graft razor (for which an ordinary broad razor or microtome blade may be substituted); two small probes; straight scissors; [scalpel]; anatomical forceps; rubber tissue; strips of rubber tissue, $\frac{1}{2}$ to $\frac{3}{4}$ inch wide, cut from the sheet after it has been disinfected and thoroughly rinsed in 0.9 per cent.* salt solution; three basins of "physiologic salt solution," for the rubber strips, the sponges and dressing, and the surgeons' hands, respectively; flat gauze compresses of appropriate size; gauze-, cotton- or sea-sponges; absorbent cotton; and bandages.

For the success of the graft it is important that strict asepsis should be employed, and yet that no antiseptic should come in contact with the wound or the surface from which the epithelium is taken, after their preliminary cleansing.

It is therefore necessary that the operating fields, the surgeon's and assistant's hands, the basins, gutta-percha strips and the sea-sponges (if these are used) should all be washed with "physiologic salt solution." This is to be made by adding sixty-nine grains *(very roughly* a *scant* teaspoonful *) of table salt or, preferably, of chemically pure sodium chlorid, to each pint needed of *tepid* sterilized water. The solution should be made in a pitcher or basin that has been disinfected and then washed out with sterile water.

After "boiling" all the instruments, except the razor, they should be rinsed in water and wiped dry. The razor should be washed with antiseptic soap, then with alcohol, dipped for a few seconds in the boiling soda solution, rinsed

* See foot-note under "Intravenous Infusion."

in sterile water and dried. "Boiling" is too apt to dull the edge of such an instrument and, moreover, it would warp the handle of an ordinary razor, if that be used.

The wound to be treated, and the surface of the thigh or other part from which the grafts are to be taken, usually disinfected and dressed the day before, are to be uncovered and washed off with salt solution. The thigh is then covered with a towel wet in the solution, while the wound is being

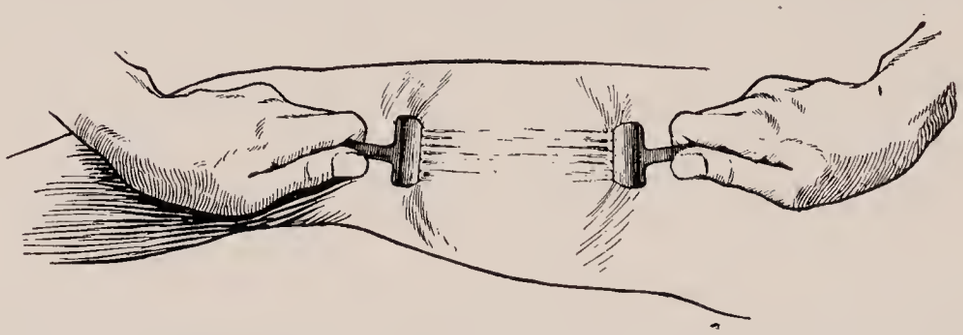


FIG. 117. Skin-grafting. Stretching the skin with McBurney's hooks.

prepared to receive the grafts. For this there is handed first the spoon with which to curette the exuberant granulations usually present. The scalpel is also needed sometimes to pare unhealthy wound edges. The assistant then washes the bleeding surface with salt solution and applies a dry compress to check oozing while the grafts are being shaved.

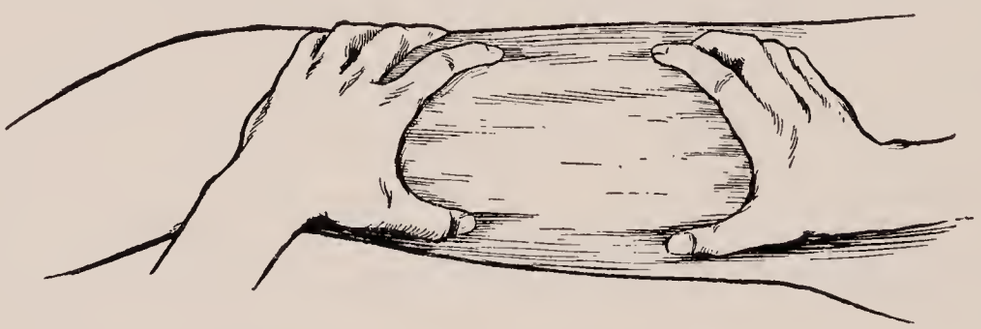


FIG. 118. Skin-grafting. Stretching the skin with the hands.

The skin-furnishing surface is now uncovered again and the surgeon is provided with the razor and a probe. The skin is put upon the stretch in a longitudinal direction. This is done by using the McBurney retractors as shown in figure 117, or by the pressure of two sticks of wood, or by the hands alone applied as shown in figure 118.

The stretching may be done by the assistant alone, or by the surgeon below and the assistant above. A strip of skin about two inches wide is thus kept evenly and tightly stretched and, by the proper application of the retractors or the hands, somewhat elevated above the skin on each side of it. As the razor is moved along the assistant should drip salt solution upon it from a sponge, enough to flood the surface of the blade without, however, washing off the epithelial strip gathering upon it. Usually the surgeon transfers each strip to the wound as soon as it is cut. The assistant removes the compress, gently dries the surface and then, with a second probe, assists the operator in spreading the grafts evenly on the wound. When all are in place the pieces of rubber tissue are needed. These the assistant lifts from their basin with thumb forceps, cuts them of appropriate length (usually the width of the wound) and hands them one by one *in the forceps*. The grafts covered with the gutta-percha, there are supplied compresses of gauze moistened in salt solution, then rubber tissue again, or oiled silk, [absorbent cotton], and a bandage. Gutta-percha strips and moist compresses are similarly prepared to dress the surface from which the grafts were shaved.

Instead of these rubber tissue strips, Cargile membrane—sterilized "gold-beater's skin," sold dry in sterile envelopes—is sometimes used in the same way, and silver foil has also been suggested. Since all of these macerate the underlying epithelium some surgeons apply a dry dressing directly over the grafts; for this the assistant hands first a *single* layer of gauze, and then gauze compresses and a bandage.

INTRAVENOUS INFUSION.

The assistant may be called upon to administer an intravenous saline infusion himself, while an operation is in progress, and the technic will, therefore, be described in detail.

In hospitals, where emergencies are frequent and shock or severe hemorrhage has often to be dealt with, the armamentarium for this procedure should be always at hand and ready for use. A box, divided into one large and three

small compartments, may be employed for the purpose*: In the large compartment are kept, all sterilized and rolled in sterile gauze within a sterile towel: one sharp scalpel wrapped in cotton; one pair of straight scissors; one pair of curved scissors; bandage scissors; one anatomical forceps; one mouse-tooth forceps; one pair of small sharp retractors; two artery forceps; one metal infusion canula, with rubber tube and glass attachment tip; one needle holder; two surgical needles. The three small compartments hold, respectively: a small jar containing, in alcohol, a reel of medium sized (No. 2) catgut; a jar containing several pads of iodoformized gauze; a sterilized two-inch bandage, wrapped in sterile gauze. Pasted inside the cover of the box should be a list of the above-mentioned contents with directions to the nurse for their resterilization, replacement and replenishment. In each ward should be kept, strictly for this purpose, a graduated five-pint infusion (irrigating) bottle and attached tubing; a glass funnel; [a glass graduate]; and a bath thermometer—all covered, and not only aseptic but scrupulously clean; and, if hot sterile water is not on tap, a demijohn of distilled water and a special kettle in which to heat it. The other articles needed are: the packages or tablets of sodium chlorid (c. p.); a piece of rubber sheeting; a few sterilized towels; several cotton sponges; sublimate solution; and soap, brush, water, and ether.

Not all of the items just listed are essential and, indeed, in the emergencies of private practice an intravenous infusion may be safely administered with no other paraphernalia than a torn handkerchief tourniquet; a pair of scissors; a strand of spool cotton; a fountain syringe; a glass irrigating tip or stout aspirating needle to serve as a canula; filtered, boiled tap water; table salt; a teaspoon; and a clean handkerchief to bind upon the wound. The fountain syringe and tubing should be *washed out* and then boiled for as many of fifteen minutes as the urgency of the case will allow. The glass infusion bottle possesses the advantages over the rubber bag that it allows one to note the rate of flow of the

* Brickner, Mt. Sinai Hospital Reports—Vol. I.

solution and to determine, also, that no shred of cotton or other foreign substance be floating in it. This last, of course, is very important and, too, it is important that the lumen of the tubing and of the canula should harbor no particles of rust or other embolus-making accumulation. Lacking both bottle and fountain syringe the solution may be introduced, through a funnel and tubing, from a pitcher, the funnel being kept continuously full to prevent the admission of air into the vein.

The solution is made by filtering into the bag or bottle,

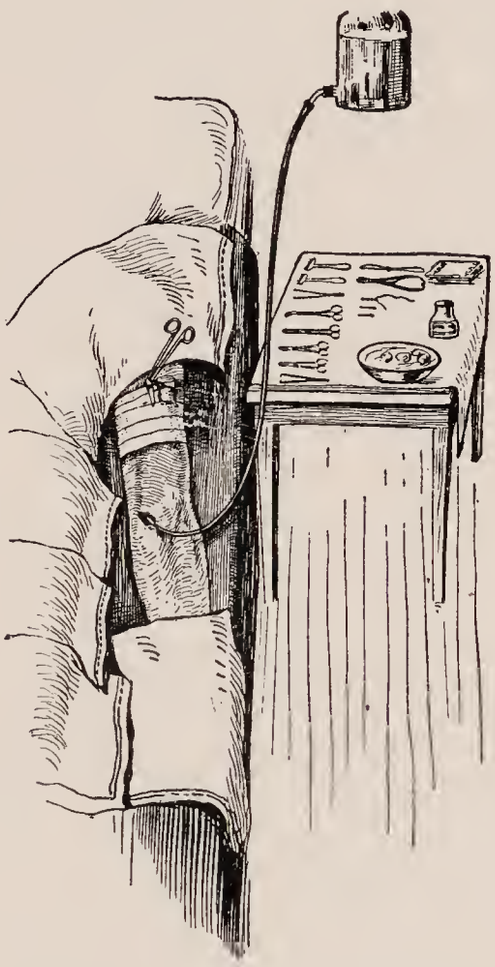


FIG. 119. Intravenous infusion.

through several thicknesses of sterilized gauze, plain water boiled and cooled to about 110° F., or cold sterile water heated to that temperature, in which *after* the boiling or heating there has been dissolved sodium chlorid (sterilized by baking in an oven, or by boiling in a few ounces of water)

in the proportion of nine grammes to each liter (69 grains to each pint.*) The reservoir should be hung about two feet above the level of the patient.

While the solution is being thus prepared the operator disinfects the skin with soap and water, ether, and sublimate

* This yields a 0.9 per cent. solution ("normal," or better called "physiologic" saline solution). The most recent physiologic teaching is that the proportion of sodium chlorid in the blood is not, as formerly held, 0.6 per cent., but 0.84 per cent. A 0.9 per cent. solution of sodium chlorid has the same freezing point as blood, and therefore the same osmotic pressure. "The difference between .84 and .9 per cent. probably represents the amount contributed to the osmotic effect by the many other compounds of the plasma." (Mathews—Annals of Surgery, August, 1904.)

A scant teaspoonful of table salt is, roughly speaking, the quantity for each pint of solution. Such a means of measuring, however, is inaccurate and is therefore justified only in an emergency. Properly, the solution should be made from a concentrated stock solution or from chemically pure sodium chlorid sterilized in packages of exact weight (69 grains, 138 grains, etc.). Infusion salt tablets, manufactured for this purpose, are very convenient, but it must be remembered that often the directions given with them are for a 0.6 per cent. solution. A tablet of 30 grains (2 grams) yields a solution of approximately 0.9 per cent. strength when dissolved in ℥ vii (210 c.c.)

Although sodium chlorid, the most abundant of the inorganic salts of the blood, is the only one absolutely essential to the solution, Mathews and others have pointed out that it is not a matter of indifference whether or not the other blood salts are represented, especially in cases of toxemia, etc., where the infusion is repeated at intervals. Mathews gives, as the formula for a "balanced" physiologic solution: sodium chlorid, .9; potassium chlorid, .03; calcium chlorid, .02; water, 100. Tablets containing various combinations of the blood salts are made by manufacturing chemists, in addition to the plain sodium chlorid tablet, *e. g.*, Sharp & Dohme infusion tablet No. 2: sodium chlorid, 2.25 grams; potassium chlorid, 0.075 gram; calcium chlorid, 0.025 gram; John Wyeth & Co. infusion tablet No. 3: sodium chlorid, 2.0 grams; sodium carbonate, 0.3 gram (for "alkaline" infusion); Parke, Davis & Co. tablet: sodium chlorid, 9.0 grams; calcium chlorid, 0.25 gram; potassium chlorid, 0.1 gram.

solution, a piece of rubber sheeting or oilcloth being placed under the extremity to protect the bed or table. The veins

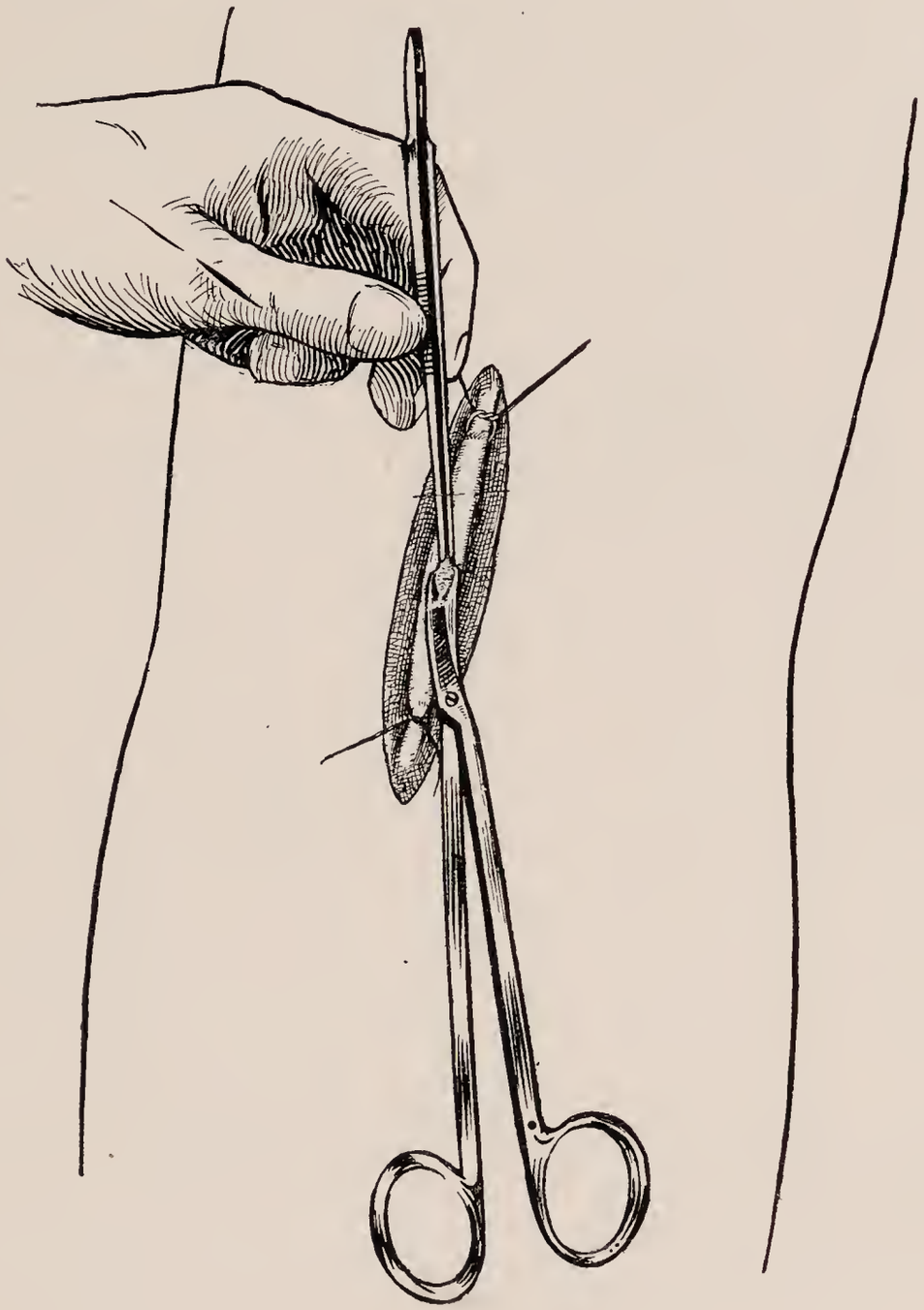


FIG. 120. Intravenous infusion. Opening the vein.

in the cubital fossa accommodate themselves best to the operation and the median basilic vein is usually chosen, but any superficial vein, *e. g.*, one of the sapheni, may be used.

After disinfecting his hands the operator makes three or four turns of the bandage about the upper arm, sufficiently

tight to constrict the veins. Towels are then spread about the field. An incision about an inch long is made along and directly over the most prominent vein in the cubital fossa, and with scalpel and forceps the vessel is freed from the connective tissue on each side. The handle of the scalpel is thrust under it to separate it from its bed along the extent of the wound. With forceps or ligature carrier a loop of

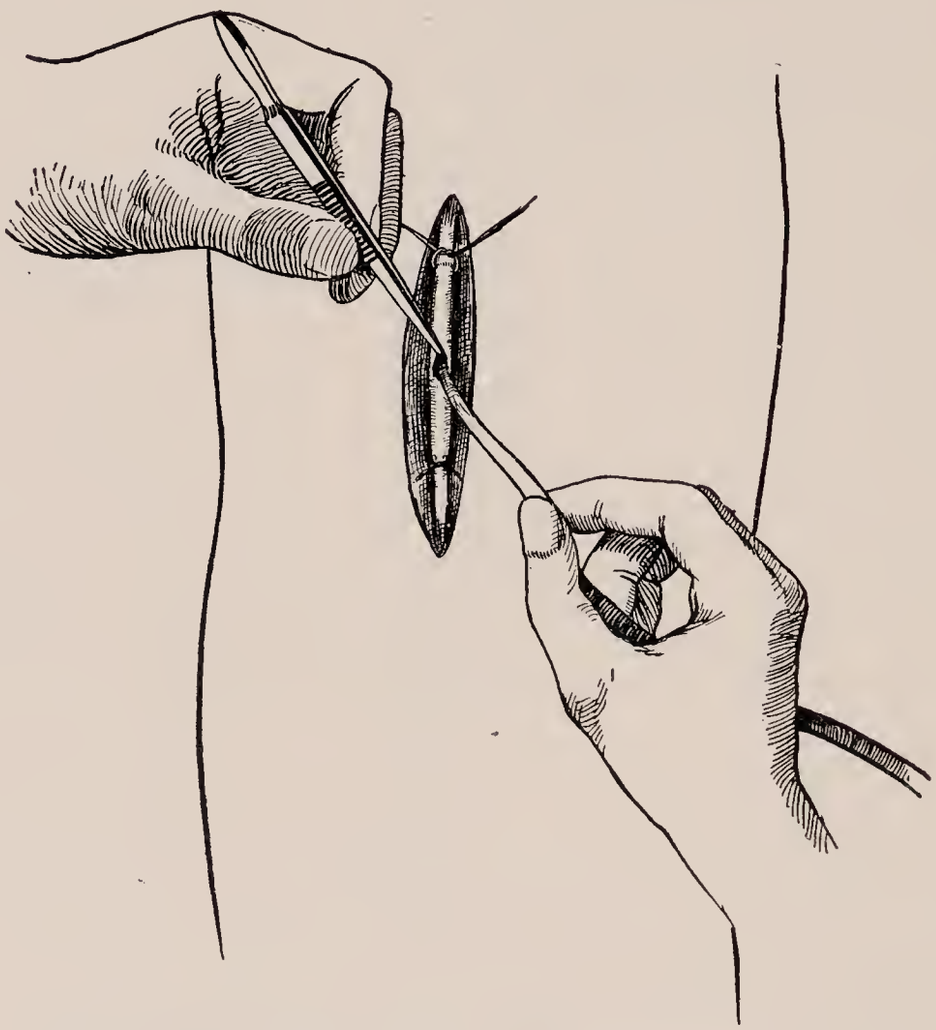


FIG. 121. Intravenous infusion. Introducing the canula.

catgut is then drawn beneath the vein and cut in two. One strand of gut is tied tightly about the distal end of the exposed vein segment and the other strand is loosely placed in a single knot about the proximal end. The upper surface of the vein is next lifted with anatomical forceps, and with curved scissors an oblique opening is cut half way across the vein. The dissection and opening of the vein are

ordinarily easy, but if the vessel is collapsed or very small they may require much delicacy. Where the vessel is lost to view or mutilated in an effort to incise it, it will usually save time to abandon it and seek an entrance through some neighboring vein. The canula is now attached to the tubing leading from the reservoir, and a little of the fluid is allowed to run on the operator's hand; this is both to drive all air out of the tube and to determine that the solution has not cooled below a proper temperature.* The solution still running, the little flap formed in the vein is raised and the canula is thrust well in. The single knot of the loose ligature is drawn about the vein and canula and, at the same time, the constricting bandage is cut through. The level of the fluid in the jar is now noted in order to observe the rate of flow, which should not be very rapid, and the quantity used. Under no circumstances should the level of the solution in the reservoir be allowed to sink as far as the level of the outlet.

In cases of shock, suppression of urine, etc., one to one and one-half pints, occasionally two pints, of salt solution are employed for an adult of average weight. Larger amounts are apt to cause great congestion of the viscera. When the infusion is injected to supply loss of blood, however, the quantity may be regulated in a measure by the severity of the hemorrhage. The effect upon the pulse at the opposite wrist should be watched.

As the canula is being withdrawn the proximal ligature is tied firmly about the vein, which is then divided between the two ligatures. The little wound, left open or closed with a few stitches, is dressed with a simple compress of gauze.

In hospital practice the preparation for, and performance of, an intravenous infusion can be accomplished within fifteen minutes, and even in the home it ought not to take much longer. Occasionally a chill and an evanescent rise of temperature (even as high as 106° F.) follow the infusion, but

* Intravenous infusions are employed at various temperatures up to 120° F. It is open to question whether there is any advantage in having them above the body temperature (98°.6–100° F.).

usually they are of no evil significance. (It has been suggested that they are the result of a destruction of red blood cells by an infusion not physiologically balanced.)

SUBCUTANEOUS SALINE INFUSION. (HYPODERMOCLYSIS.)

The solution is prepared in the same manner as for intravenous infusion. The reservoir is hung about three feet above the patient. Attached to the tubing is a stout aspirating needle which, while the solution is flowing, is thrust

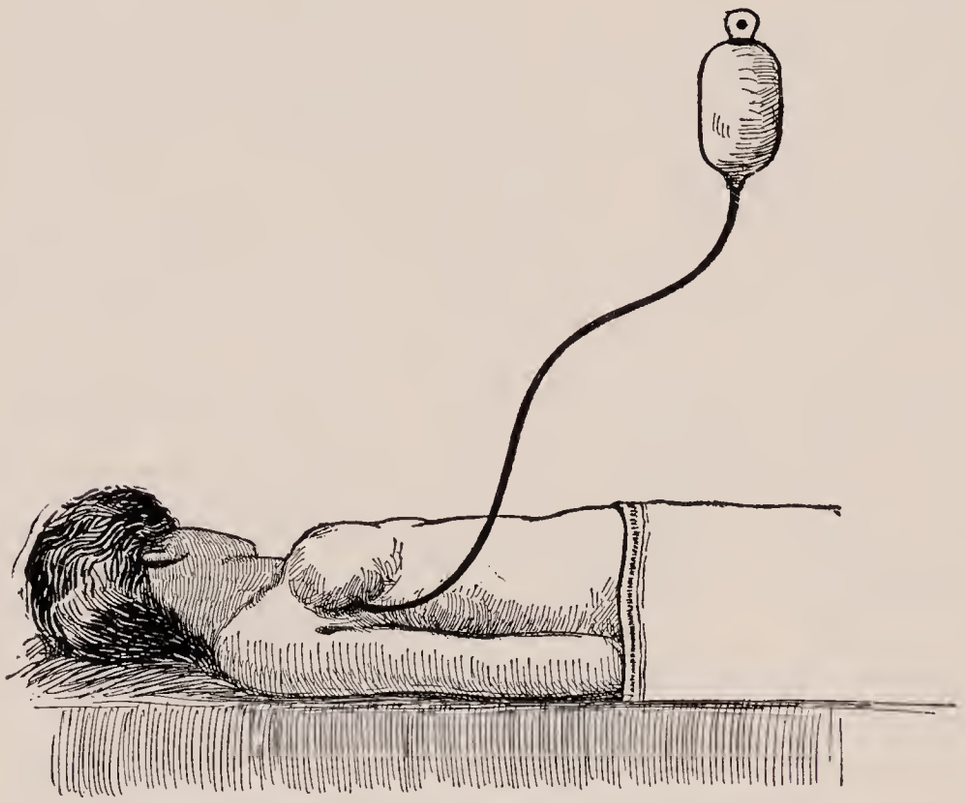


FIG. 122. Subcutaneous saline infusion.

almost horizontally into the subcutaneous tissue of the back (loin) or the buttock or under the female breast. The puncture wound must be covered with a bit of sterile gauze or with collodion. The latter will not adhere to the skin if the puncture hole is wet or bleeding. To obviate the difficulty the skin about the tiny wound is pinched up tightly and wiped dry, the collodion dabbed on, and the compression continued for a minute or two thereafter.

APPENDIX I.

APPENDIX I.

THE PRELIMINARY PREPARATION AND ROUTINE AFTER-TREATMENT OF OPERATIVE CASES.

FOR AN OPERATION UNDER GENERAL NARCOSIS TO BE PERFORMED IN THE EARLY AFTERNOON.

The patient is allowed a light supper (*e. g.*, coffee, toast and one egg) the evening before. The morning of the operation a cup of tea or coffee is allowed for breakfast, but nothing thereafter. In many cases, however, water may be allowed until about an hour preceding the operation.

About three or four o'clock of the preceding afternoon there is administered an active purge, *e. g.*, pulv. glycyrrhizæ comp. ℥ ss, or magnesium sulphate ℥ ss, or a mixture of pulv. glyc. co. and magn. sulphat. āā ℥ ii, or oleum ricini ℥ ss, or hydrarg. chlorid. mit. (*e. g.*, a series of six one-half grain doses of calomel given at ten-minute intervals). About ten o'clock of the same evening a high soapsuds enema is administered, and this is repeated about six o'clock the next morning. At ten o'clock (four or five hours after the second high injection) a low enema is given.

Just before the purgative is administered [the patient is given a warm bath and] the field of operation is carefully shaved, scrubbed with soap and water and covered with a "soap poultice." This consists in an abundance of loose gauze, wrung out in a lather of green soap, covered with rubber tissue or oiled silk, and held in place with a bandage. When the second high enema is given, the soap poultice is removed, the skin washed with alcohol and ether, and gauze wet in sublimate solution, 1-3,000, applied. This dressing is not removed until the operation.

After operation,—Morphin is frequently needed. Cath-

eterization at eight-hourly intervals may be necessary. All nourishment by mouth is withheld for four to six hours or until vomiting ceases. Fluid diet is maintained until the bowels are moved. This is ordinarily done on the second day after the operation by means of a high soapsuds [and peppermint water] enema in the morning, and a cathartic (pil. cathartic. vegetabile or pil. cathartic. comp. or cascara sagrada, etc.) the same evening.

RECTAL OPERATIONS *(e. g.,* hemorrhoids).

The bowels are moved as above but, in addition, low enemata are repeated until the fluid returns clear, and a rectal tube is inserted for half an hour two hours before the operation. The perineum is shaved and prepared as above.

After operation,—For two days fluid diet is maintained, and the bowels are confined by the administration of tinct. opii deod. ♏x b.i.d. On the morning of the third day there is administered Epsom salt ℥ ss, followed in two hours by an injection of olive oil (through the tampon canula) and an hour later by a low soapsuds enema. Thereafter solid or semi-solid diet is allowed.

ABDOMINAL OPERATIONS.

In emptying the bowels it is best to employ the additional procedures described for rectal operations. For an operation upon the *female pelvic organs* the vagina is also prepared *(vide infra). Stomach operations.*—For 36-48 hours preceding the operation the diet should be only of sterilized fluids, and the mouth is to be kept clean by the free use of a tooth-brush and of an antiseptic mouth-wash *(e. g.,* equal parts of peroxid of hydrogen and of sublimate solution, 1-10,000). An hour before the operation gastric lavage is performed, preferably with sterile water or saline solution and a sterile stomach tube.

After operation,—The time and manner of moving the bowels depend, to a great extent, upon the nature of the operation and the condition of the patient. In the presence

of peritonitis, the bowels are moved in twenty-four hours. For tympanites, an enema of peppermint water, to which may be added ʒ i-ii of oil of turpentine, may be indicated. In cases in which gauze drainage through the vagina is employed, voluntary urination is not to be permitted until the gauze is removed.

OPERATIONS UPON THE NOSE.

An antiseptic spray or douche is to be used freely beforehand.

OPERATIONS UPON THE MOUTH OR THROAT.

Tooth-brush and mouth-wash are to be used as for gastric operations.

BLADDER OPERATIONS.

In addition to the other preparations, urinary disinfectants (*e. g.*, urotropin, gr. VII t.i.d.), the free drinking of water, [and bladder irrigations] are employed.

Preparatory to a cystoscopic examination without general narcosis, an enema is administered in the morning if the bowels have not moved, and half an hour before the examination an opium suppository is inserted.

After the passage of instruments through the urethra, the administration of quinin (gr. x) is often desirable as a preventive of "urethral chill."

VAGINAL OPERATIONS.

Douches of bichlorid of mercury, 1-5,000, are administered morning and evening before the operation, and after the last enema on the day of the operation. The external genitals are shaved (except sometimes for curettage, drainage of pelvic abscess, etc.) and prepared by soap poultice and sublimate dressing as are other fields of operation.

After operation.

Curettage, trachelorrhaphy. The vaginal gauze is removed after twenty-four hours; the uterine gauze after

forty-eight. The bowels are moved on the second day, and sublimate douches, 1-5,000 are administered daily after all gauze is out.

Plastic operations (colporrhaphy, perineorrhaphy). Until the morning of the fourth day, the thighs are bound together, fluid diet is maintained, tinct. opii deod. ♏x are administered b.i.d., and catheterization is performed every five hours. On the fourth morning Epsom salt ℥ ss is given, followed in one hour by an enema of olive oil ℥ iv, and after another hour by a low soapsuds enema. Thereafter semi-solid diet is begun, a douche and an enema are administered each morning, and voluntary urination is permitted. Until the wound heals, however, it is to be washed off and a fresh gauze pad is to be applied, after each urination and defecation.

Vaginal hysterectomy and other operations in which a communication is made between the vagina and the abdominal cavity. Catheterization is to be performed at regular intervals until the drainage gauze is removed.

EMERGENCY CASES.

To patients requiring operation before the bowels can be regularly prepared a low enema may be administered. In the presence of an intra-abdominal abscess (appendicitis, etc.), a high enema is contra-indicated, and the preparation of the skin must be conducted with great gentleness.

THE PREPARATION OF SURGICAL MATERIALS; FORMULARY.

CATGUT.

Of the commercial gut only strands that are clean, strong, *rough* and *yellow* should be selected.

Bichlorid Method. (v. Bergmann.)

(a). 1. Wind in rings or on spools.
2. Remove all fat by immersion in commercial (sulphuric) ether for twenty-four hours or longer,

changing the ether if necessary [or by soaking in benzin for a whole month].

3. Remove from ether and place upon a towel to dry.
4. Place in

 hydrarg. chlorid. corrosiv.....1
 alcohol 95 per cent.....500

 small sizes (00 and 0) for nine days, larger sizes for fourteen days.
5. Transfer to alcohol 95 per cent. Preferably keep in alcohol two weeks before using.

(Mt. Sinai Hospital, N. Y.)

There are various modifications of this method. Thus:

(b). 1, 2. Select and wind gut and remove fat as in (a).

3. Pour off ether and cover gut with

 hydrarg. chlorid. corrosiv.....20
 distilled water.....400
 alcohol 2000

 Renew this solution three times at intervals of twenty-four hours.
4. Soak for twenty-four hours in absolute alcohol.
5. Preserve in fresh alcohol.

(Philadelphia German Hospital.)

(c). 1, 2. As in (a).

3. Place in

 hydrarg. chlorid corrosiv.....gr. xx
 acid. tartaric.....gr. c
 alcohol 95 per cent.....℥ vi

 smaller sizes five to seven minutes, medium sizes ten to fifteen minutes, largest sizes twenty to thirty minutes.
4. Preserve in alcohol 95 per cent., to each eight ounces of which is added one drop of a solution of palladium chlorid. (gr. xv to ℥ i).

(Johnston's quick method, employed at Jefferson Hospital, Philadelphia.)

*Claudius' Method.**

The raw gut, without any fat-removing preparation, is

* Deutsche Zeitschrift f. Chirurgie, Vol. 64, p. 489.

simply wound in single layers on glass spools and dropped into a solution of

iodin (pulverized).....1.
potassium iodid.....1.
distilled water.....100

in a well stoppered jar, and left there eight days. Before using, the iodin may be washed off by rinsing the spool in an aseptic solution, but if the gut is used directly from the solution, it will be more distinctly antiseptic (iodin). Unused portions of gut are re-sterilized by returning them to the same (or, better, another) jar of the solution for from half an hour to eight days, according to the contamination to which they have been exposed. Catgut prepared by this cheap and simple method is strong, smooth, not swollen, pliable, knots easily, does not curl up as does gut kept in alcohol, and is absorbed in about the same time as catgut prepared by other methods. If it be left in the solution more than three or four months, however, it is apt to become too brittle.

*Elsberg's Method.**

1. Free the raw gut of fat by immersing it for twenty-four to forty-eight hours in ether or in chloroform, or in a mixture of

 chloroform 1
 ether 2

2. Wind *tightly, in a single layer,* on large glass spools having a hole in each flange, in which the ends of the gut can be tied.
3. Boil for ten to thirty minutes in a saturated solution of ammonium sulphate in water, or for three to ten minutes in a saturated solution of ammonium sulphate in aqueous carbolic acid solution, 1 per cent. to 2 per cent.
4. Remove the spools with sterile forceps, and rinse them for half to one minute in warm sterile water, carbolic acid, or sublimate solution.
5. Use at once or preserve in strong alcohol.

* International Clinics, Vol. 1., 11th Series.

Catgut can be re-sterilized (from three to six times) by boiling again. The solution can be used repeatedly by simply adding water to replace that which has evaporated; the ammonium sulphate crystallizes out unchanged.

Cumol Method (Krönig).

1. Remove all fat with ether, chloroform or benzin.
2. *Suspend* it, rolled in rings or in figure-of-eight forms, in a glass beaker or large test-tube.
3. Heat in an oven or over a sand-bath at 80° C. for two hours.
4. Still *suspended* in the beaker, pour in cumol at 100° C. and heat to or nearly to 165° C., maintaining that temperature one hour. (Cumol boils at a little above 165° C.)
5. Pour off cumol and dry in an oven or over a sand-bath at 100° C. for two hours.
6. With sterile forceps transfer to alcohol.

This method is complicated, difficult and not without danger, and is not suitable for office preparation.

Boiling in Alcohol.

Alcohol boils at 174° F., which temperature is not sufficiently high to sterilize catgut. The alcohol must, therefore, be boiled under pressure, to accomplish which special apparatus is required.

(a). In an apparatus the fat-freed gut is boiled fifteen minutes in a mixture of

liquified phenol.....5
distilled water.....10
ethyl alcohol.....85

(Saul's Method.)

(b). Fat-freed catgut is wound on a glass spool and placed in a glass tube. This tube is nearly filled with alcohol, its end is hermetically sealed, and it is then subjected in an autoclave to live steam at 248° F. for an hour.

When needed, the glass tube is broken and the catgut dropped into sterile water to soften it.

Formalin Method.

(a). 1. Remove fat from gut by ether, chloroform or benzin.

2. Wind on glass plates in not more than one or two layers.

3. Soak for twelve to forty-eight hours in 2 per cent. to 4 per cent. aqueous formaldehyd solution (1-2 parts of commercial formalin in twenty parts of distilled water).

4. Remove formalin by soaking twenty-four hours in running water.

5. Boil the formalin-hardened gut in distilled water fifteen to thirty minutes.

6. Preserve in

acid carbolic.....4
or
hydrarg. chlorid. corrosiv.....1

glycerin 5
alcohol 96 per cent.....100

(Hofmeister's technic.)

or cut the catgut in pieces, tie them in bundles and preserve in a glass-stoppered jar containing

pulverized iodoform.....100
glycerin 50
absolute alcohol.....950

Shake the mixture every few days.

(Senn's modification of Hofmeister's technic.)

(b). 1. Cut the raw gut into required lengths.

2. Wrap each piece separately in filter-paper that has been soaked for twenty-four hours in a 2 per cent. solution of formaldehyd. Leave thus for twenty-four hours.

3. Dry in the paper at a temperature of 140° F.

4. Preserve dry until needed; then soak a few minutes in a sterile solution.

(Vollmer-Kossman technic.)

(c). *(Formol-iodin).*

1. Submerge raw commercial catgut in 4 per cent. aqueous formalin solution thirty-six to forty-eight hours.
2. Wash in running water twelve hours.
3. Submerge in Claudius' iodin solution *(vide supra)* eight days.

(Stone's modification of Claudius' method, to increase tensile strength of gut.*)

Dry Heat Method of Boeckmann.

1. Soak in ether one week to remove fat.
2. Wrap in strands in fine tissue- or paraffin-paper, and seal in paper envelopes.
3. Place envelopes in sterilizer and subject them for three hours to a dry heat of 284° F., and for four hours to 290° F.; or to 300° F. for three hours on two successive days.
4. When needed, cut off end of envelope, remove inner package with sterile forceps, and dip gut in sterile water to make it pliable.

Chromicizing Catgut.

(a). 1. Roll catgut on spools.
2. Alcohol 95 per cent. for twenty-four hours.
3. Dry on a towel.
4. Place in

potass. bichromat.....gr. LXXV
aqueous solution carbolic acid, 5%...5 pints

small sizes for forty-eight hours, large sizes for fifty-two hours.

5. Alcohol 95 per cent., small sizes for five days, large sizes for three to four weeks.

(b). 1. Place 200 parts by weight of catgut for twenty-four to forty-eight hours in

carbolic acid.....200
water 2000
chromic acid.....1

* Medical Record, November 12, 1904.

2. Preserve in alcohol.

(Am. Text-Book of Surgery.)

(c). 1. Remove fat with ether.
2. Place for twenty-four hours in a 4 per cent. aqueous solution of chromic acid.
3. Dry in a hot-air sterilizer.
4. Sterilize by one of the above methods.

(d). *Elsberg's Method.*

Boil spools of catgut in 1-1000 aqueous chromic acid solution saturated with ammonium sulphate. Other steps as for Elsberg's method of plain sterilization.

The resistance of the catgut to absorption in the tissues varies with the strength of, and duration of exposure to, the chromicizing solution.

KANGAROO TENDON.

Kangaroo tendon is prepared in much the same manner as chromicized catgut. It should always be chromicized.

Marcy's Method.

1. Soak the dried tendon in sublimate solution, 1-1,000.
2. Separate the individual strands.
3. Dry each strand in a sterile towel.
4. Chromicize *(vide supra)*.
5. Keep in

carbolic acid.....5
boiled linseed oil.....100

6. When needed, wipe the oil off of each strand with a sterile towel and immerse for half an hour in 1-1,000 aqueous solution of bichlorid of mercury. (This does not swell and soften the tendon as it would catgut.)

Truax' Method.

1, 2, 3. As in Marcy's technic.
4. Immerse in aqueous solution formaldehyd, 2 per cent. to 4 per cent. for forty-eight hours.
5. Wash in running water twelve to twenty-four hours.

6. Immerse tendons until "dark golden brown" in a fresh solution of
 chromic acid.....1
 carbolic acid.....200
 water 4000
7. Dry between sterile towels and preserve in 10 per cent. carbolized oil.
8. When needed, wipe off each strand with a towel saturated with sublimate solution, 1-1000.

CRANE AND HERON TENDON.*

May be sterilized by the method of Claudius *(vide supra)*.

HORSEHAIR.

1. Wash with water and potash soap.
2. Boil ten to fifteen minutes in 4 per cent. carbonate of sodium solution.
3. Preserve in sublimated alcohol, 1-1000.

SILK.

Wind on glass spools and boil vigorously, small sizes for fifteen minutes, larger sizes for half an hour, in 5 per cent. carbolic acid solution or 1 per cent. carbonate of sodium solution. Preserve in 5 per cent. carbolic acid solution or in sublimated alcohol, 1-1000.

CELLULOID THREAD.

English gray linen thread is boiled in 1 per cent. solution of carbonate of sodium, then wrapped in a sterile towel, dried in hot air or steam and, finally, is dipped in a solution of celluloid heated in a hot-air sterilizer, and is placed in a sterile container.

* The leg tendons, 11-16 inches long, of grallatorial birds are recommended by Kieffer (Journal Am. Med. Assoc., November 19, 1904), as being readily procured, clean, easily sterilized, strong, tying well, and resistant to absorption for about six weeks.

SILKWORM-GUT.

(a). 1. Cut off the rough ends of the commercial silkworm fibers.
2. Boil in 5 per cent. carbolic acid solution, or in plain water for half an hour (never in sodium carbonate solution).
3. Preserve in plain or sublimated alcohol, in carbolic acid solution 1 per cent. to 5 per cent., or in lysol solution ½ per cent.

(b). 1. As in (a).
2. Place in ether for forty-eight hours.
3. Corrosive sublimate solution, 1-1000, for one hour.
4. Preserve as in (a).

(c). 1. As in (a).
2. Soak fifteen minutes in 5 per cent. carbolic acid solution.
3. Sterilize by live steam.
4. As in (a).

Silkworm-gut is easily dyed, and incidentally impregnated with an antiseptic, by immersing it for twenty-four hours in a 1 per cent. solution of methyl violet, before it is boiled.

SEA-SPONGES.

(a). 1. Select firm, well-beaten sponges.
2. Place for twelve hours in
commercial muriatic acid.....1
water 3
3. Wash and squeeze out repeatedly in running water.
4. Soak three to four days in 5 per cent. green soap in water, stir, wash and squeeze out.
5. Wash until clean in running water.
6. Place in 5 per cent. carbolic acid solution at least twenty-four hours. Preserve in carbolic acid solution. (Mt. Sinai Hospital, N. Y.)

(b). 1. Beat out dust.
2. Place for forty-eight hours in 15 per cent. solution muriatic acid.
3. Wash with water.
4. Place for one hour in a solution of
potassium permanganate..... ʒ iii
water 5 pints
5. Soak four hours in a solution of
sodium hyposulphite..... ℥ x
hydrochloric acid..... ℥ v
water.....3 pints
6. Wash with running water for six hours.
7. Preserve in sublimate solution, 1-1000.

(From Da Costa's "Modern Surgery.")

WAX OR PARAFFIN PAPER.

(a). Melt the wax or paraffin. While pouring it on thin [tissue] paper, iron evenly with a hot flatiron.

(b). Dip the paper in melted wax or paraffin, then pass it through a laundry mangle.

RUBBER TISSUE (GUTTA-PERCHA).

Sterilize by:

1. Washing and soaking in green soap and cold water.
2. Rinsing in plain water.
3. Immersing for twenty-four hours in sublimate solution, 1-1000.
4. Preserve in sterile water or salt solution, or in a sterile towel.

RUBBER TUBING.

1. Cut in lengths.
2. Blow out dust.
3. Boil in plain water ten minutes.
4. Dry on sterile towel.
5. Keep in 5 per cent. carbolic acid solution.

RUBBER GLOVES; CATHETERS.

(See Chapters V. and VII.)

MURPHY'S GUTTA-PERCHA SOLUTIONS.

Benzin solution, 4 per cent. for surgeon's hands; acetone solution, 4 per cent. for field of operation.

1. Cut the gutta-percha chips in small pieces.
2. Wash in formalin, full strength, and dry.
3. Macerate the chips in benzin or acetone for three days, then filter through cotton that has been in formalin vapor for forty-eight hours. Repeat filtering twice, and solution is ready for use. The benzin is sterilized by boiling it in a water-bath in a strong, well-corked bottle. The gutta-percha solution itself loses its adhesiveness if boiled, and it is not miscible with formalin.

(Method of E. von Hermann, chemist.*)

TRAUMATACIN.

A saturated solution of gutta-percha in chloroform.

SENN'S DECALCIFIED BONE CHIPS.

1. Saw the shaft of the femur or the tibia of a recently killed ox into sections two inches in length.
2. Remove periosteum and marrow, and place the remaining segments for two to four weeks into 15 per cent. solution of hydrochloric acid, changing the solution daily.
3. Wash decalcified segments in distilled water.
4. Immerse a few minutes in dilute potash solution to neutralize the remaining acid.
5. Immerse in distilled water for twenty-four hours.
6. Cut each, in direction of its long axis, into strips three-quarters of an inch wide; slice strips into chips one millimeter thick.
7. Preserve chips in sublimated alcohol, 1-500.

VON MOSETIG-MOERHOF BONE-FILLING.

1. Mix

iodoform	60
spermaceti	40
oleum sesami	40

* Murphy, Journal A. M. A., September 17, 1904.

2. Heat slowly to 100° C. in a flask on a water bath; keep at that temperature fifteen minutes.
3. Allow to cool and solidify while shaking constantly.
4. When needed, melt and heat to 50° C. in a thermostat.

HORSLEY'S BONE WAX.

1. Mix

salicylic acid	1
almond oil	1
beeswax	7

2. Boil ten minutes.
3. Pour in shallow dish to cool; cover.

PARAFFIN FOR SUBCUTANEOUS INJECTION, ETC.

Mix commercial paraffin with sufficient petroleum jelly to reduce melting point to desired degree, *e. g.*, 110° F., as determined accurately with thermometer. Proportions cannot be stated, for blocks of commercial paraffin are not of the same melting point throughout. When needed, boil the mixture in a flask or tin receptacle placed in the water in a sterilizer; cool in the flask to about 120° F.; draw into sterile syringe; evacuate air bubbles from syringe and place it in sterile water at 80° F. to allow paraffin to cool in it uniformly to semi-solid state. Before injecting, warm the attached syringe needle in hot water.

(Harmon Smith's technic.)

PLASTER BANDAGES.

The best dental plaster, kept in air-tight containers, should be used. Gauze or crinolin, cut in strips about five yards long and of the desired width, is laid upon a table and the plaster is *smoothly* and *evenly* rubbed into its meshes. In order that the plaster will not be spilled out of the strip, it should be rolled up little by little as the powder is incorporated in it. The bandage, *very loosely rolled,* is wrapped up in waxed paper or gutta-percha, and placed in a tin box, the cover of which is sealed around the edge with a strip of adhesive plaster.

STARCH BANDAGES.

Cheese-cloth impregnated with starch and dried is cut into strips of desired width and rolled up.

WATER GLASS (SOLUBLE GLASS) DRESSING.

The wound is dressed and bandaged in the ordinary way. Into and upon the bandage is applied with a brush liquor sodii silicatis (U. S. P.) or liquor potassii silicatis, or a mixture of two parts of the latter with one part of the former. (The combination is said to set more quickly and firmly than either solution used alone.)

Instead of painting on the soluble glass, the bandages may be dipped into it and then applied.

TOWELS, CAPS AND GOWNS.

1. Remove blood, pus, etc., by soaking several hours in cold water, to which may be added some ammonia.
2. Rinse in several changes of cold water.
3. Boil in soap and soda for about an hour.
4. Rinse in plain water.
5. Dip in bluing.
6. Wring out.
7. Dry.
8. Iron and fold; wrap in a package in a sheet or bag or place in a sterilizing drum.
9. Steam-sterilize and dry in autoclave. (New towels should be boiled before using, to prevent stiffening.)

ABSORBENT AND NON-ABSORBENT COTTON.

Cotton, in rolls, pads or "sponges" may be steam-sterilized and dried in an autoclave.

BORATED COTTON.

Immerse sterilized absorbent cotton in a saturated aqueous solution of boracic acid; wring out and allow to dry slowly.

PLAIN GAUZE; GAUZE PADS AND SPONGES.

If ordinary cheese-cloth is used, it is boiled in soft soap or soda to remove the grease and make it absorbent. After the boiling it is rinsed and dried, folded in a package and sterilized in a towel, a jar or a canister, in an autoclave (250° F., fifteen pounds pressure, at least fifteen minutes). Sponges and pads are made of several folds of gauze, the edges of which are turned in and hemmed to avoid loose threads. Abdominal pads should have a narrow tape strongly sewed to one of the corners. Pads, sponges and "packings" (the edges of which are similarly folded in) are sterilized in packages like the dressing gauze.

BICHLORID GAUZE.

Wring out sterile gauze in:

hydrarg. chlorid. corrosiv.....gr. x
sodium chlorid.....℥ ss
acid citric.....℥ i
glycerin.....℥ ss
aq. destillat.....℥ ii
(Enough for sixty yards.)

Keep moist or dry in sterile jars, well stoppered. The citric acid and sodium chlorid are added to the solution to prevent decomposition of the mercurial salt.

(Formula from Senn's "Nurse's Guide.")

CARBOLIZED GAUZE.

Wring out sterile gauze in:

acid carbolic.....℥ iii
glycerin.....℥ xviv
aq. destillat.....℥ ii
(Enough for sixty yards.)

Preserve the same as sublimate gauze.

(Formula from Senn's "Nurse's Guide.")

IODOFORMIZED GAUZE.

(a). 1. With disinfected hands, wring out pieces of gauze in aqueous sublimate solution, 1-500.

2. Shake pieces out loose and mix them thoroughly, one by one, and then altogether in

powdered iodoform.....℥ i
glycerin.....℥ i
aq. sublimate solution, 1-1000.... ℥ xxxii

(This quantity is enough for sixteen yards. The mixture makes a 3 per cent. gauze).

3. Fold in packages; sterilize in towel or jar in the autoclave. (Mt. Sinai Hospital, N. Y.)

(b). 1. Soak gauze uniformly in a mixture of

iodoform 20 parts
glycerin 20 parts
alcohol 70 parts, by weight
(5 per cent. mixture.)

2. Wring out as dry as possible.

3. Fold in packages or rolls; place in aseptic jars and seal hermetically.

(c). 1. Place sterile gauze in 20 per cent. ethereal solution of iodoform for ten minutes.

2. Wring out and place in basin covered with sterile towel to allow ether to evaporate. (Gauze now greenish-blue.)

3. Soak twelve hours in aqueous sublimate solution, 1-4000. (Gauze restored to yellow color and antiseptic.)

4. Wring dry as possible.

5. Fold; place in sterile jars. (Pryor's Method.)

To improve the Color of Iodoformized Gauze,—

For each thirty yards add to the mixture about a dram of tincture of curcuma, prepared thus: Mix,

powdered curcuma.....℥ iv
proof spirit.....1 pint

Let stand until clear; pour off clear liquid; add spirit until all color is extracted. (From Senn's "Nurse's Guide.")

IODOFORM EMULSION.

Use iodoform, 1 part; glycerin, 9 parts (by volume or weight).

Boil the glycerin, pour it into sterile bottle, allow it to cool, add iodoform, cork with sterile stopper, shake.

IODOFORM-ETHER.

A saturated solution of iodoform in sulphuric ether.

IODOFORM-COLLODION.

Iodoform, gr. xlviii; collodion, ℥ i.

STRONGER IODIN TINCTURE.

Iodin crystals		2 parts
alcohol, ether	āā	5 parts

Keep in glass-stoppered bottle. This is twice the strength of the officinal tincture. (Elsberg.)

BALSAM OF PERU AND CASTOR OIL (OILY DRESSING).

Mix Peruvian balsam, 1 part, and castor oil, 10 parts; pour into clean bottle; plug neck with cotton; sterilize in autoclave. This is poured on the gauze when needed.

LIQUOR ALUMENI ACETATIS
(BUROW'S SOLUTION FOR WET DRESSINGS).

Plumbi acetate	3.50
alumen	9.0
aq. ad	100.0

Mix and filter. Dilute for use with five to eight times as much water. Maceration and whitening of the skin, especially of the hand and foot, by the application of gauze moistened in this solution, may be prevented by adding to the solution about one-sixth its bulk of glycerin or alcohol.

THIERSCH'S SOLUTION (FOR WET DRESSINGS AND IRRIGATION).

Salicylic acid.....3 ss (1 part)
boracic acid.....3 iii (6 parts)
water.....O ii (500 parts)

PLAIN BORACIC ACID SOLUTION.

Boracic acid.....4 parts
water.....100 parts
(Saturated solution.) Boracic acid crystals dissolve more readily than the powder.

SALINE SOLUTION.

Physiologic Salt Solution:

Sodium chlorid.....138 grains; 9 grams
water.....1 quart; 1 liter

"Balanced" Physiologic Salt Solution:

Sodium chlorid.....0.90
potassium chlorid.....0.03
calcium chlorid.....0.02
water.....100.00

SUBLIMATE SOLUTIONS.

1:10,000
bichlorid of mercury, gr. 1½; 0.1
water.....1 quart; 1 liter

1:1,000
15 grains; 1 gram
1 quart; 1 liter.

1:500
bichlorid of mercury, gr. xxx; 2.0
water.....1 quart; 1 liter

25% stock solution
8 ounces; 250 grams
1 quart; 1 liter

1:1000
25% stock solution, 3 i; 4 c.c.
water.....1 quart; 1 liter

1:500
3 ii; 8 c.c.
1 quart; 1 liter

Commercially prepared tablets containing $7\frac{3}{10}$ grains of the mercurial salt (and citric or tartaric acid) yield a 1-1000 solution in a pint of water.

CARBOLIC ACID SOLUTIONS.

Phenol crystals are liquified by setting the bottle in which they are sold in hot water; to hasten the process a teaspoonful of hot water may be poured into the neck of the bottle.

1 per cent.	2 per cent.	5 per cent. (saturated solution)
pure carbolic acid, ʒ iiss; 10 c.c.	ʒ v; 20 c.c.	ʒ xiiss; 50 c.c.
water 1 quart; 1 liter	1 quart; 1 liter	1 quart; 1 liter

CREOLIN AND LYSOL SOLUTIONS.

1 per cent.	2 per cent.
creolin; lysol, ʒ iiss; 10 c.c.	ʒ v; 20 c.c.
water 1 quart; 1 liter.	1 quart; 1 liter.

FORMALDEHYD SOLUTIONS.

1 per cent.	3 per cent. formalin-glycerin.
com'c'l formalin, ʒ vi¼; 25 c.c.	com'c'l formalin, ʒ ivss; 18 c.c.
water.....1 quart; 1 liter.	glycerin.....ℨ viii; 250 c.c.

PICRIC ACID SOLUTION FOR BURNS.

Picric acid gr. xxxviii; 2.5 grams
alcohol..... ℨ i; 30.0 c.c.
water..... O i; 250.0 c.c.

NITRATE OF SILVER SOLUTIONS.

1 per cent.	5 per cent.
argent. nitrate, gr. v; 0.3 grams.	gr. xxv; 1.5 grams.
aq. destillat.....ℨ 1; 30 c.c.	ℨ 1; 30.0 c.c.

It is important that the solution should be made with *distilled* water and preserved in dark, glass-stoppered bottles that have been rinsed out with distilled water.

COCAIN SOLUTIONS.

½ per cent.	2 per cent.
cocain hydrochlorate....gr. iiss; 0.15	gr. x; 0.6 grams
sterile distilled water....ℨ 1; 30.0 c c.	ℨ 1; 30.0 c.c.

To preserve the solution, a few grains of boracic or salicylic acid should be added.

SCHLEICH'S SOLUTIONS FOR INFILTRATION ANESTHESIA.

	No. 1 (Strong)	No. 2 (Normal)	No. 3 (Weak)
Cocain hydrochlorate	gr. ii	gr. i	gr. $\frac{1}{10}$
morphin hydrochlorate	gr. ¼	gr. ¼	gr. ¼
sodium chlorid, c. p.	gr. ii	gr. ii	gr. ii
sterile water (about ʒ ii)	♏ 1000	♏ 1000	♏ 1000

SOLUTIONS FOR ELECTRIC BATTERIES.

Carbon-zinc Galvanic "Dip" Battery.

Sulphuric acid.....4 ounces
potassium bichromate, enough to saturate.
water.....1 quart

Have the cells half full.

Leclanché Battery.

Copper pole tightly packed in a porous receptacle with a mixture of manganese dioxid and gas carbon covered with pitch; zinc pole dipping in solution of sal ammoniac.

To replenish, wash glass cell clean, put in fresh zinc rod if needed, and fill jar one-third its depth with a strong solution of sal ammoniac (ammonium chlorid)—about six ounces to the quart of water.

Gravity ("Crowfoot") Battery for charging storage cells.

Copper pole in copper sulphate solution at the bottom; zinc pole near the top of the solution.

Blue vitriol (copper sulphate) is placed in generous quantity at the bottom of the cell, and enough water is poured in to nearly fill the jar. A little common salt or sulphuric acid is added to the zinc to start the action of the battery.

ENEMATA.

Cathartic Enema.

This consists ordinarily of plain warm water or water in which a lather is made with (Castile) soap. To it, especially when administered "high," various elements may be added according to the indication, *e. g.*, olive- or cotton-seed

oil, six to eight ounces; magnesium sulphate, one ounce; inspissated ox-gall, a tablespoonful; and, to relieve tympanites: peppermint water; spirits of turpentine, one or two teaspoonfuls; tincture of asafœtida, one-half to one ounce, etc.

Stimulating Enema.

Tinct. digitalis.....mxx
whiskey.....℥ i
table salt.....ʒ ss-ʒ i
water.....℥ viii-O i
(tinct. opium.....mxx)

Nutritive Enema.

A combination such as that of some, or all, of the following:

egg.....I
peptonized milk.....℥ iv-vi
beef extract, peptonoids or somatose...℥ i-ii
whiskey.....℥ i
salt solution.....variable
(tinct. opium.....mx-xx)

APPENDIX II.

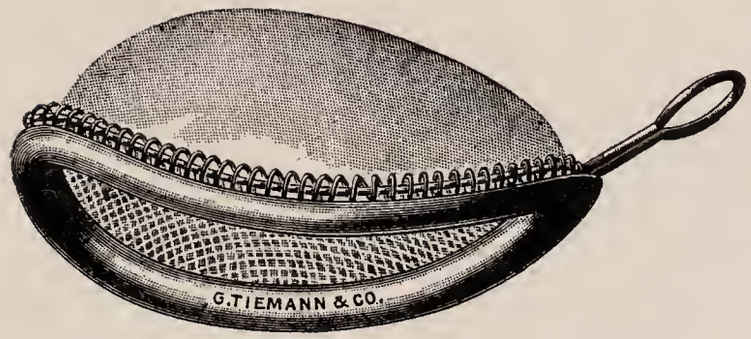


FIG. 1.—Yänkauer's chloroform mask.

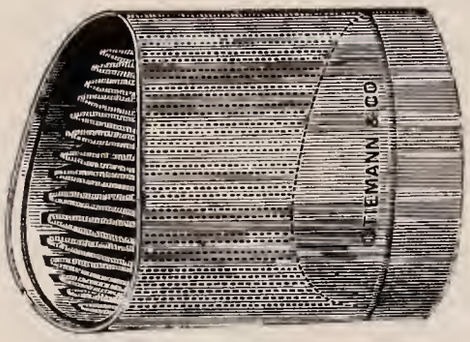


FIG. 2.—Allis' ether inhaler.



FIG. 5.—Denhard's mouth-gag.

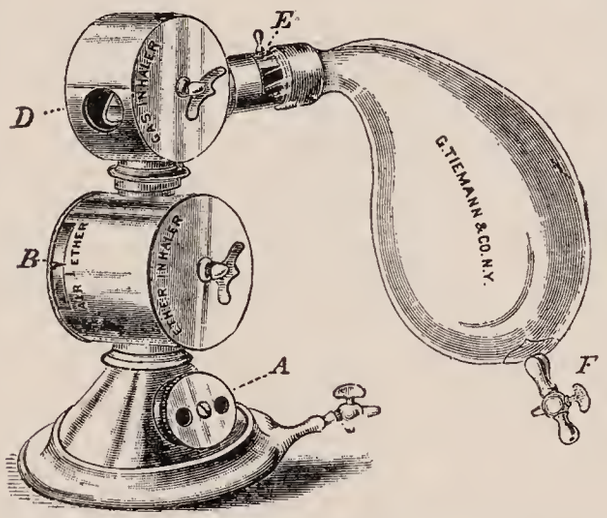


FIG. 3.—Bennett's apparatus for the administration of gas and ether. *A*, Air-trap in face-piece; *B*, ether chamber; *D*, chamber containing valved tubes for transmitting nitrous oxid gas; *E*, air-trap; *F*, stop-cock for introducing gas into balloon.

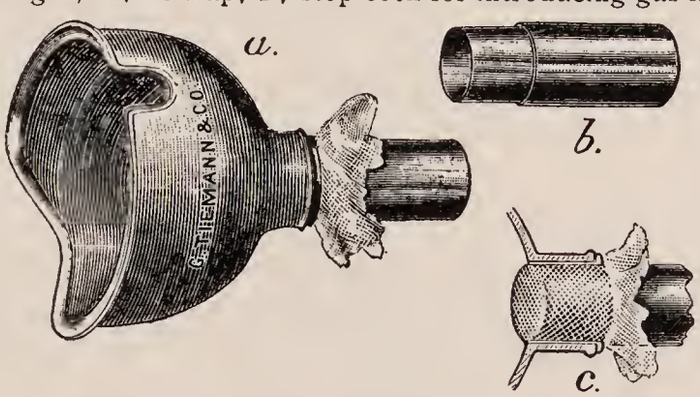


FIG. 4.—Ware's ethyl chlorid mask. *a*, face-piece; *b*, metal tube; *c*, section showing insertion of gauze.

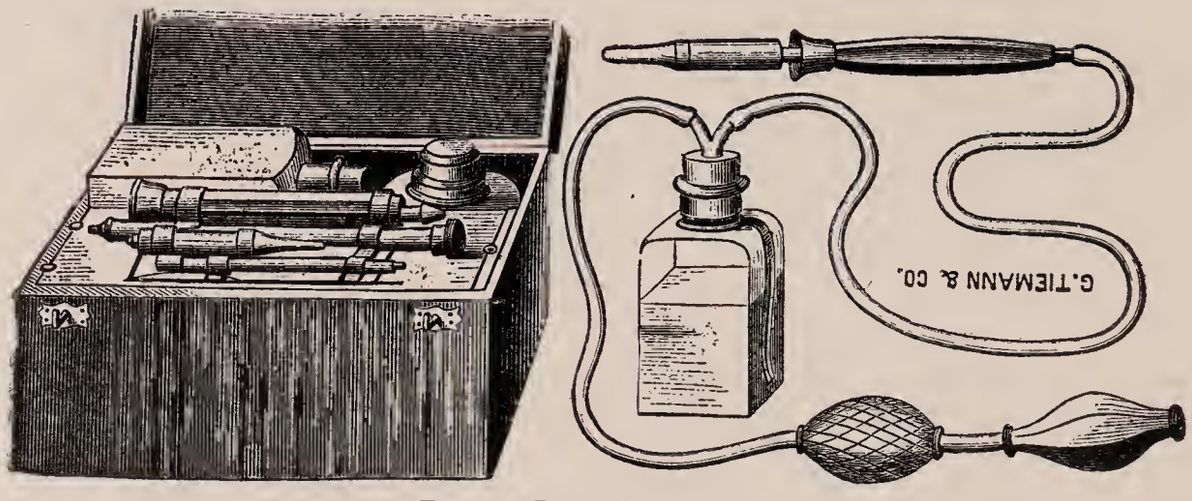


FIG. 6.—Paquelin cautery.



FIG. 7.—Gerster's iodoform duster.

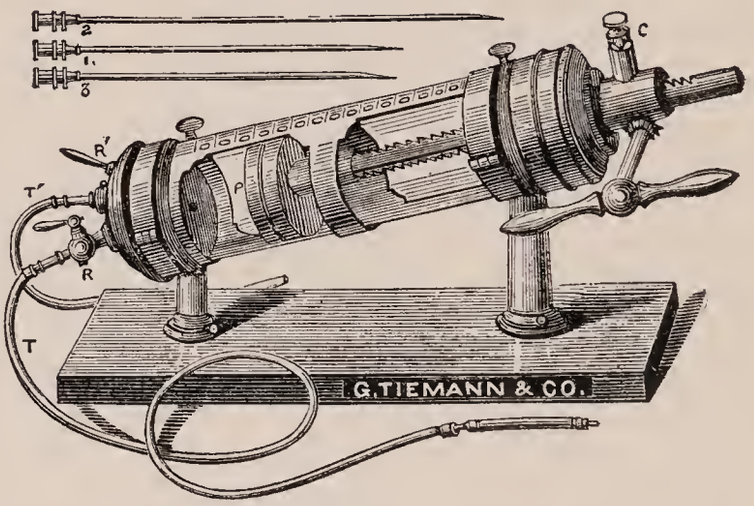


FIG. 8.—Dieulafoy's aspirator.

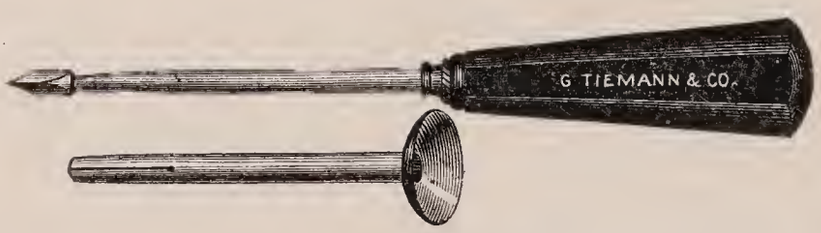


FIG. 9.—Trocar and canula.



FIG. 10.—Volkmann's spoon.

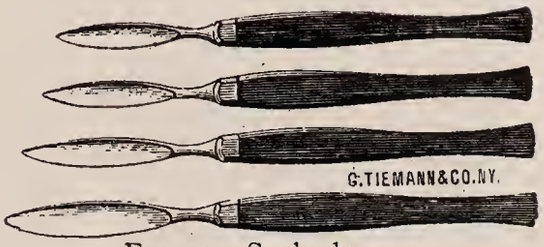


FIG. 11.—Scalpels.

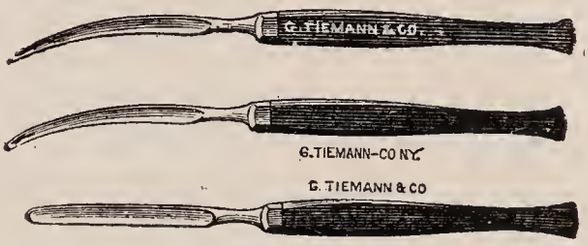


FIG. 12.—Bistouries.



FIG. 13.—Tenotome.

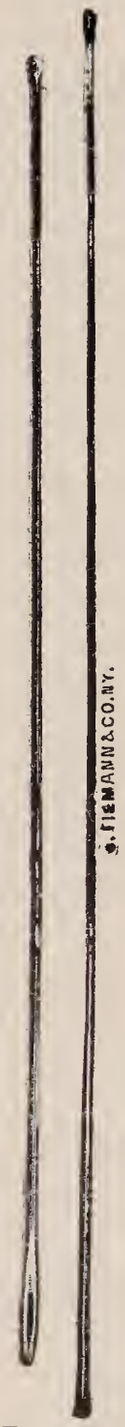


FIG. 14.—Flexible probes.



FIG. 15.—Fluhrer's aluminum probe.



FIG. 16.—Grooved director.



FIG. 17.—Amputating knife.



FIG. 18.—Catlin (Interosseous knife.)



FIG. 19.—Curved scissors.

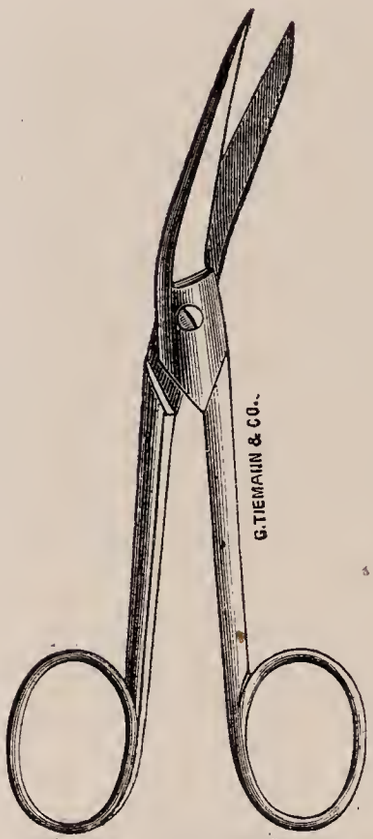


FIG. 20.—Angular scissors.



FIG. 21.—Heavy bandage shears.



FIG. 22.—One-pronged retractor.



FIG. 23.—Two-pronged retractor



FIG. 24.—Small blunt retractor.



FIG. 25.—Large (abdominal) blunt retractor.



FIG. 26.—Four-pronged retractor.

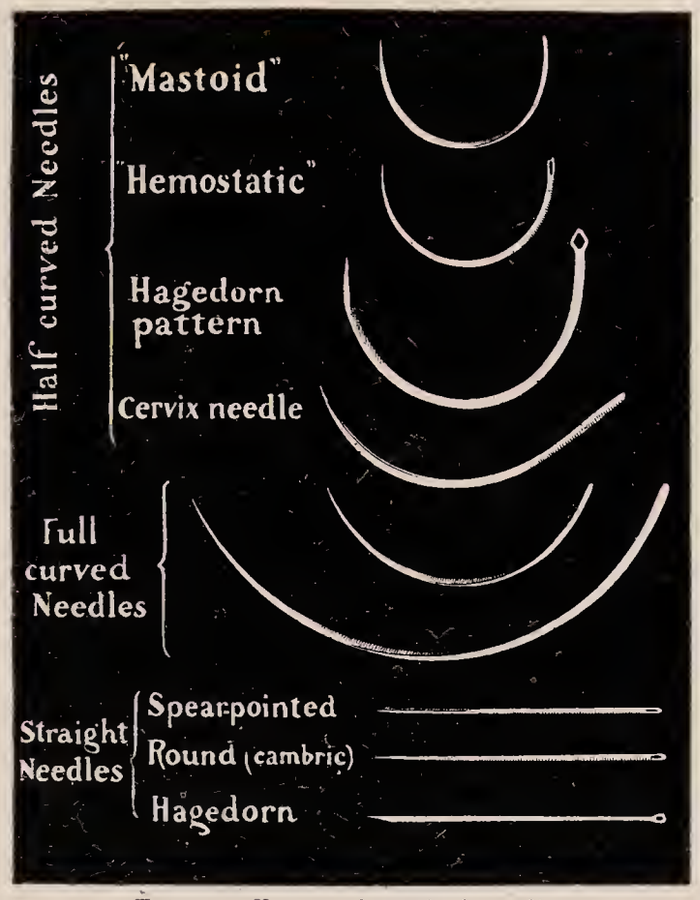


FIG. 27.—Forms of surgical needles.



FIG. 28.—Peaslee's needle.



FIG. 29.—Aneurism needle.



FIG. 30.—Ligature carrier.



Fig. 31.—Dieffenbach's needle holder.

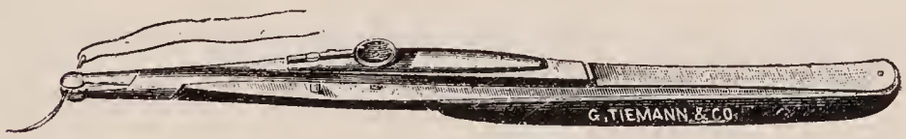


FIG. 32.—Wyeth's needle holder.

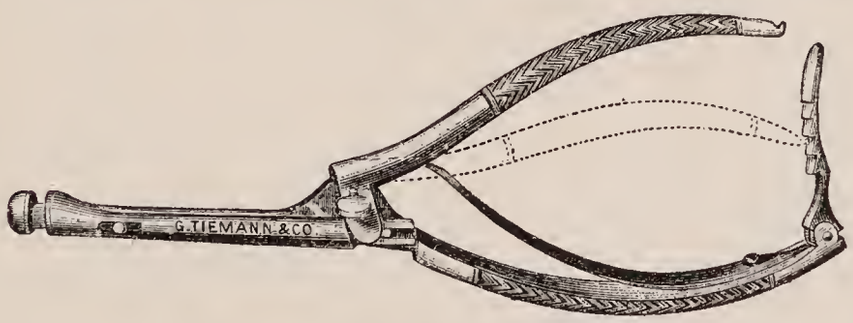


FIG. 33.—Hagedorn s needle holder.

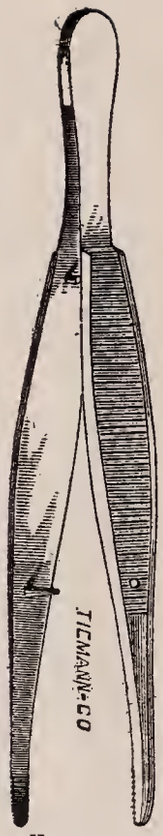


FIG. 34.—Anatomical (thumb) forceps.



FIG. 35.—Tissue forceps.



FIG 36.—Dressing forceps.

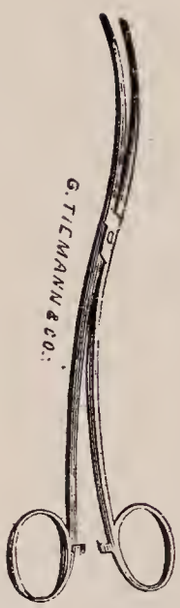


FIG. 37.—Slender (vaginal) dressing forceps.

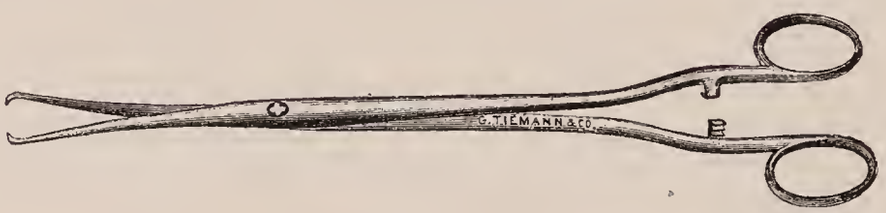


FIG 38.—Bullet forceps.



FIG. 39.—Sponge forceps.



FIG. 40.—Gerster's artery forceps.



FIG. 41.—Esmarch's bulldog artery forceps.

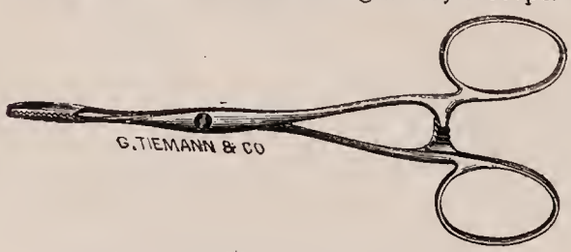


FIG. 42.—Pean's artery forceps.

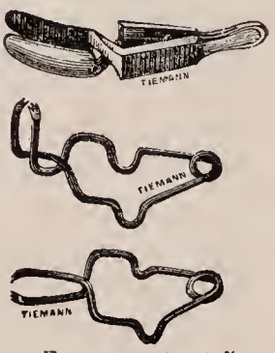


FIG. 43.—Serrefins.



FIG. 44.—Spencer Wells' straight clamp.



FIG. 45.—Skene's curved clamp.



FIG. 46.—Spencer Wells' T-shaped clamp.



FIG. 47.—Angiotribe.

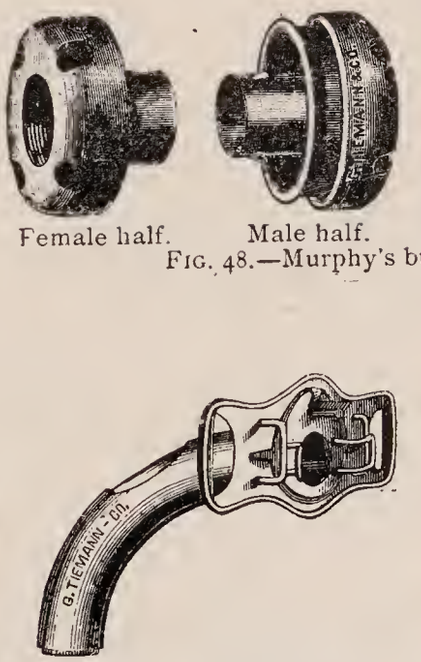


FIG. 49.—Tracheal canula.

Female half. Male half. Partly closed.

FIG. 48.—Murphy's button.



FIG. 50.—Nasal speculum.

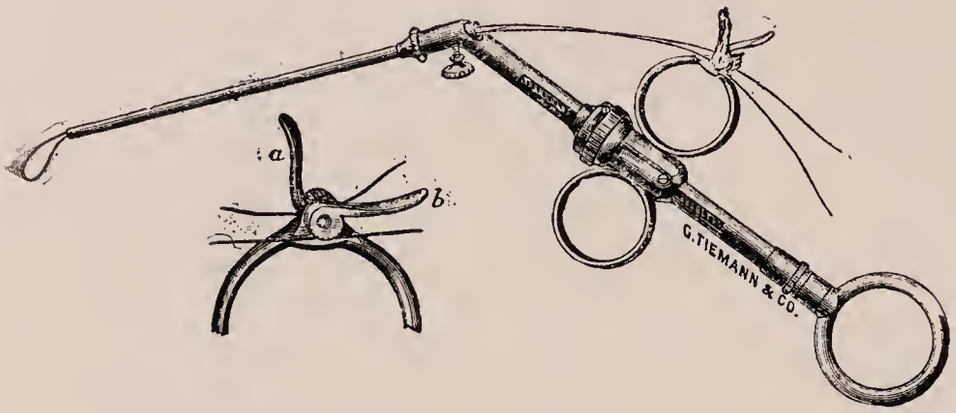


FIG. 51.—Polypus snare.

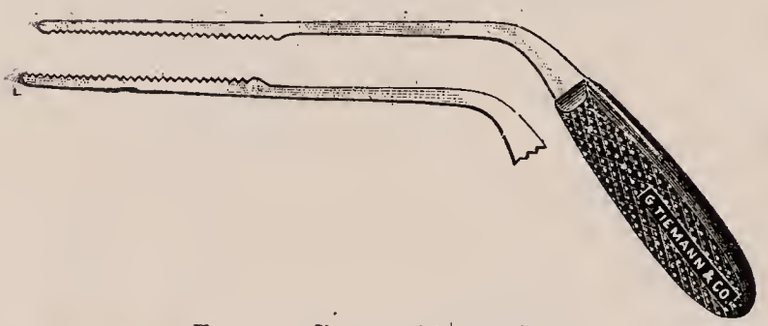


FIG. 52.—Bosworth's nasal saw.

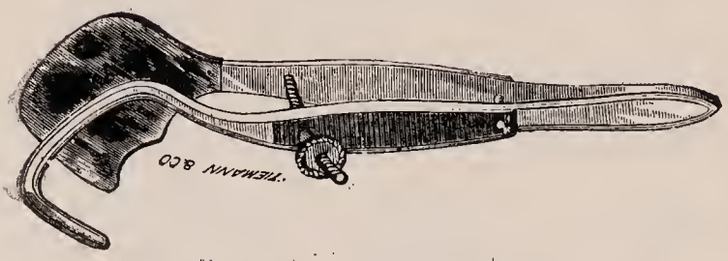


FIG. 53.—Snellen's entropion forceps.

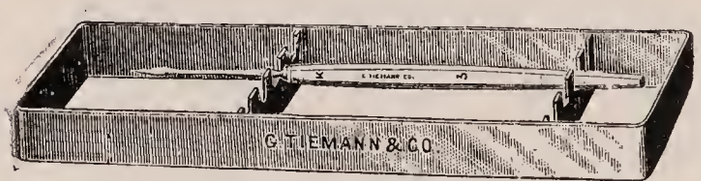


FIG. 54.—Rack for ophthalmic instruments.



FIG. 55.—Knapp's trachoma forceps.



FIG. 56.—Gottstein's adenoid curette.

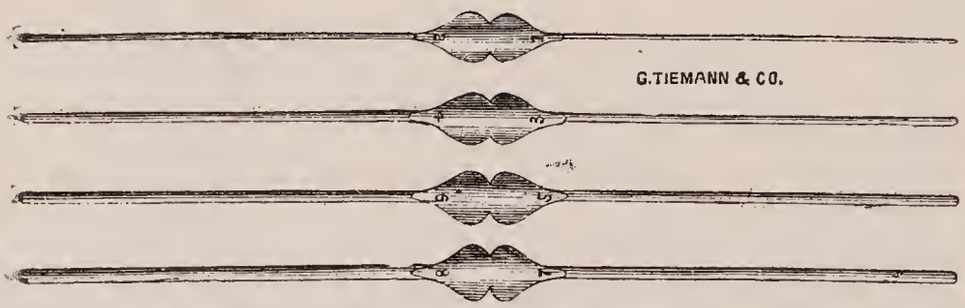


FIG. 57.—Bowman's lachrymal probes.



FIG. 58.—Wire eye speculum.



FIG. 60.—Beer's keratomè.

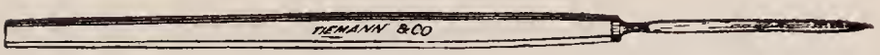


FIG. 61.—Graefe's cataract knife.



FIG. 62.—Knapp's cystotome.



FIG. 63.—Levi's fenestrated lens spoon.



FIG. 59.—Iris scissors.

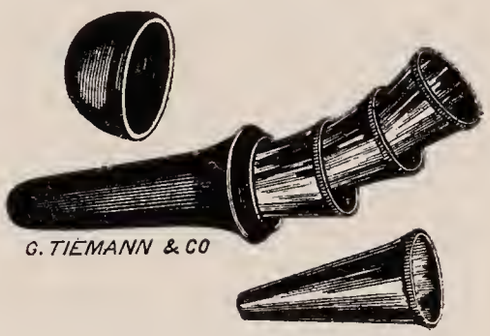


FIG. 64.—Wilde's tubular aural specula.

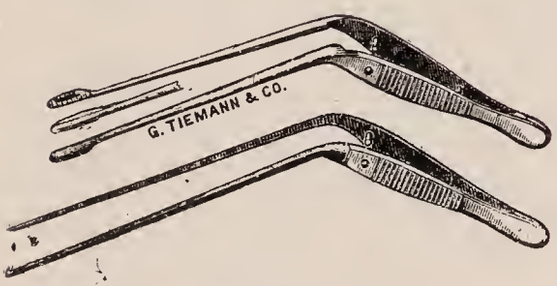


FIG. 65.—Angular ear forceps.

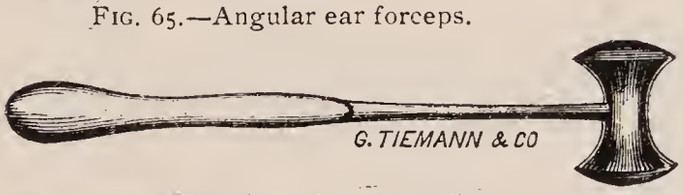


FIG. 66.—Mastoid mallet.

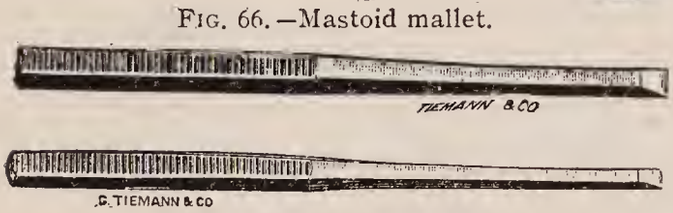


FIG. 67.—Mastoid chisels.



FIG. 68.—Mastoid gouge.



FIG. 69.—Keyhole saw.

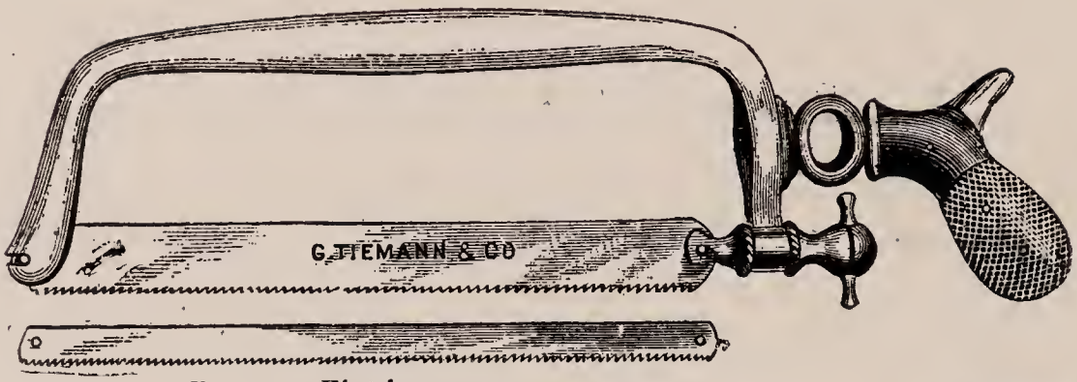


FIG. 70.—Flat bone saw.

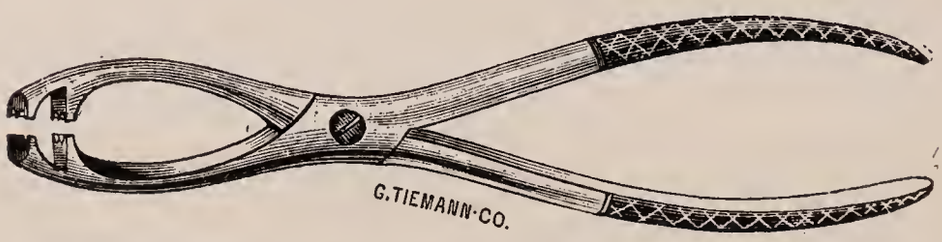


FIG. 71.—Ferguson's lion-jaw bone-holding forceps.

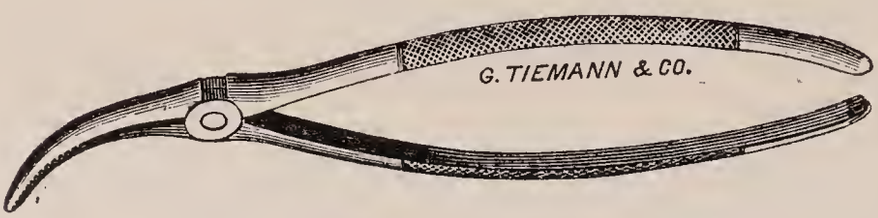


FIG. 72.—Markoe's sequestrum forceps.



FIG. 73.—Liston's bone-cutting forceps.



FIG. 75.
MacEwen's
osteotome.

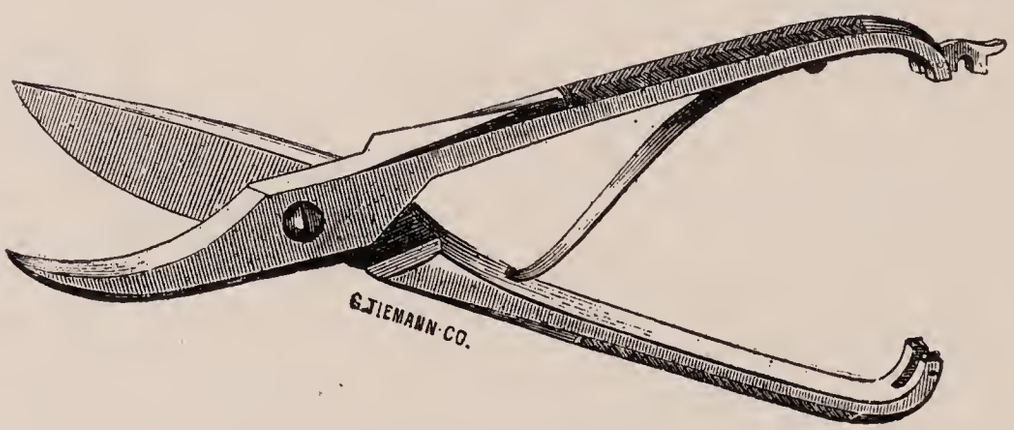


FIG. 74.—Costotome.

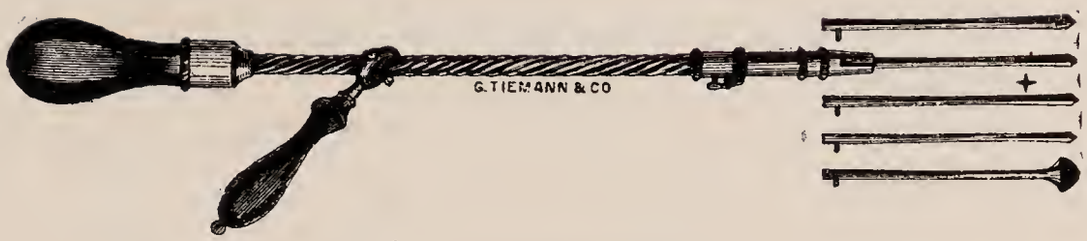


FIG. 76.—Hamilton's bone drills.



FIG. 77.—*a*, Sharp bone spoon; *b*, Periosteal eleyator.

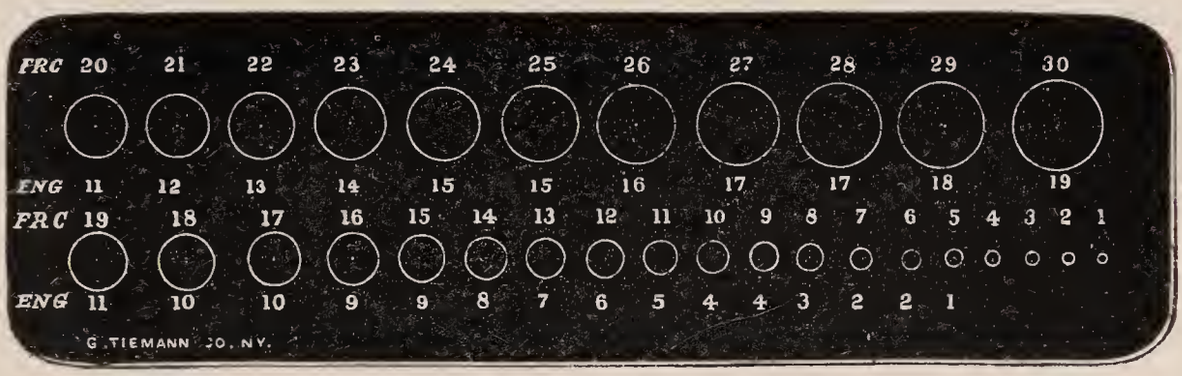


FIG. 78.—French and English urethral scales.



FIG. 79.—Olive-tipped catheter.



FIG. 80.—Olivary bougie.



FIG. 81.—Woven catheter.

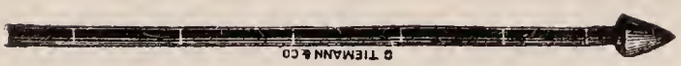


FIG. 82.—Bougie à boule.



FIG. 83.—Phimosis clamp.

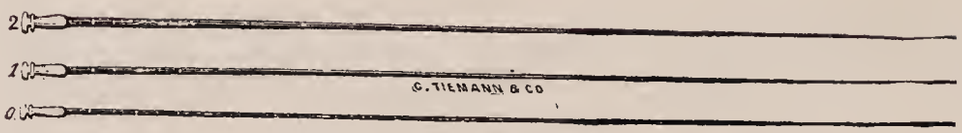


FIG. 84.—Filiform bougies.

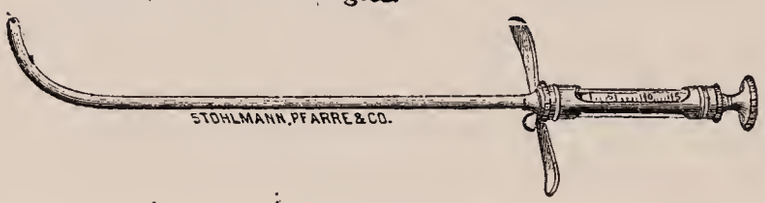


FIG. 86.—Ültzmann's urethral syringe.

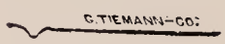




FIG. 85.—Filiform bougies.

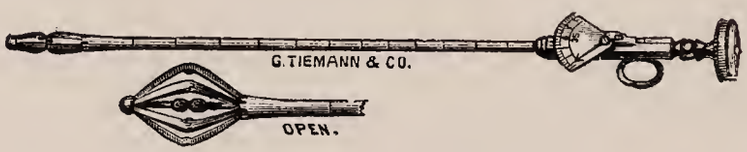


FIG. 87.—Otis' urethrometer.



FIG. 88.—Thompson's stone searcher.



FIG. 89.—Thompson's lithotrite.

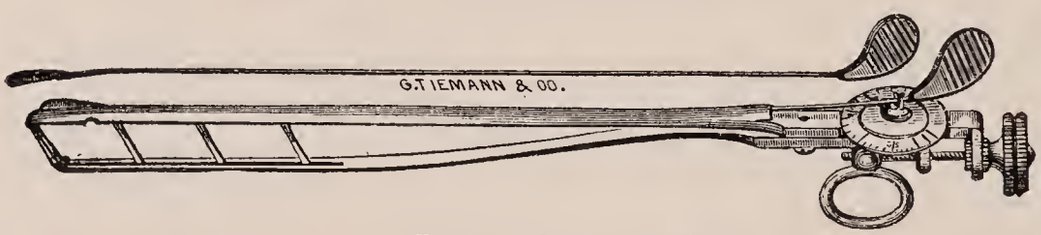


FIG. 91.—Otis' urethrotome.

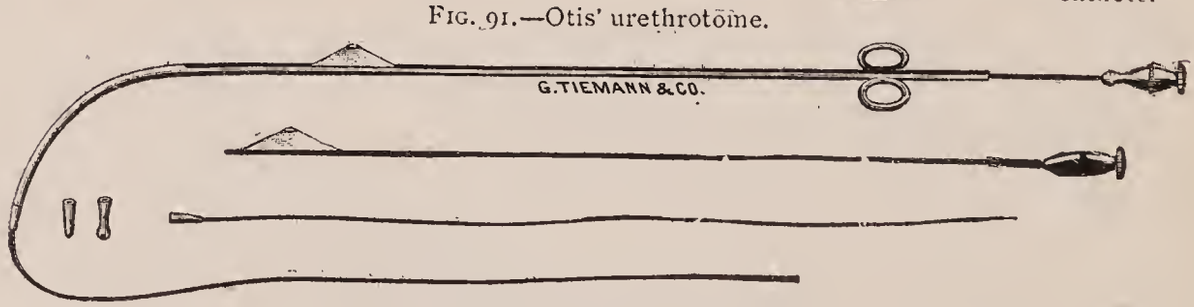


FIG. 92.—Maisonneuve's urethrotome.



FIG. 90.—Olive-tipped catheter



FIG. 93.—Endoscope.



FIG. 94.—Wheelhouse's staff.



FIG. 95.—Teale's probe gorget (urethral director).

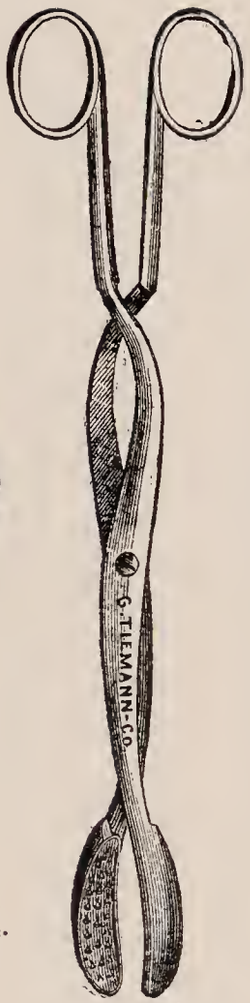


FIG. 96.—Stone forceps.

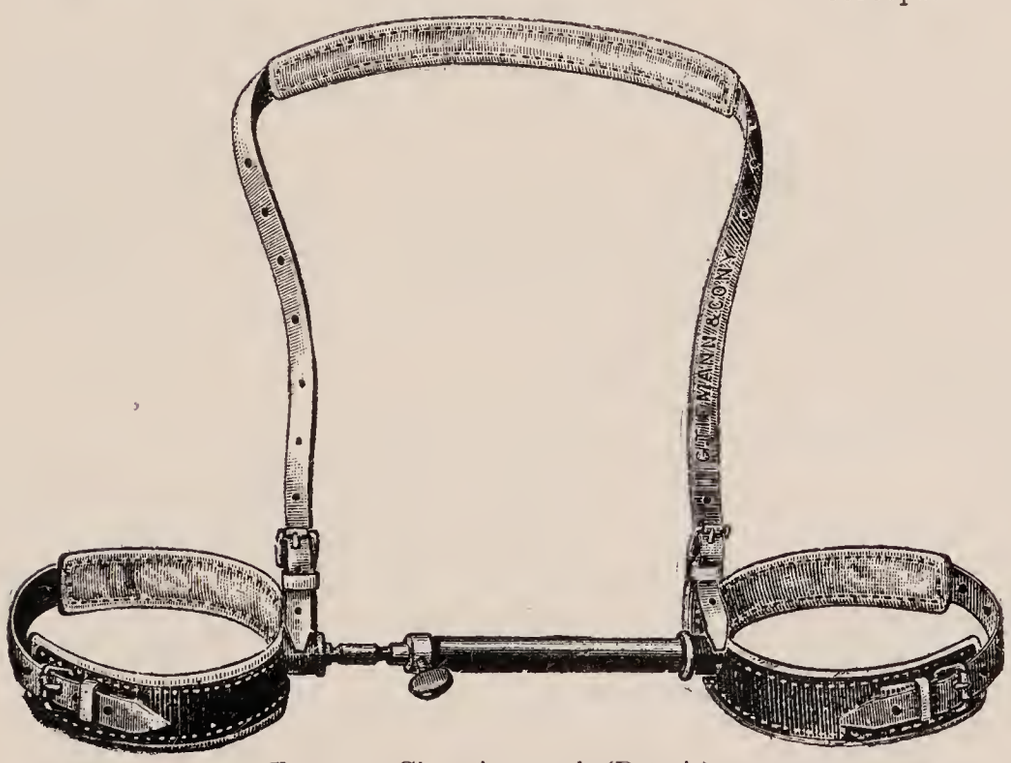


FIG. 97.—Clover's crutch (Peter's).



FIG. 98.—Tenaculum.



FIG. 99.—Volsellum.



FIG. 100.—Sims' wire adjuster.



FIG. 101.—Uterine sound.



FIG. 102.—Sharp uterine curette.



FIG. 103.—Dull uterine curette.

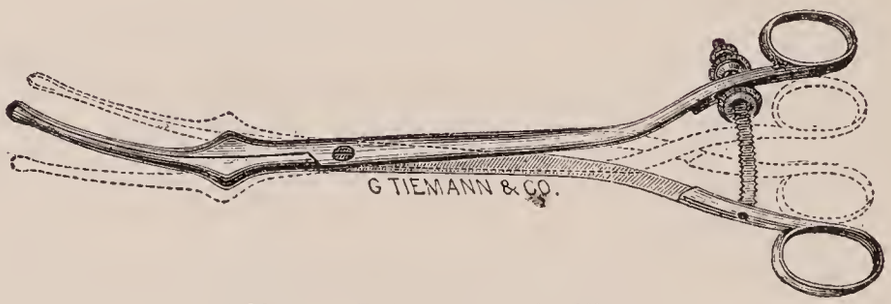


FIG. 104.—Palmer's cervix dilator.

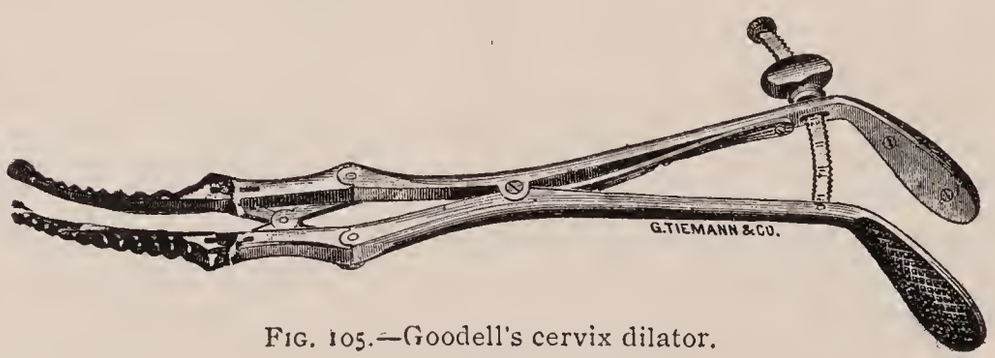


FIG. 105.—Goodell's cervix dilator.



FIG. 106.—Recurrent uterine douche nozzle.



FIG. 107.—Sims' vaginal depressor

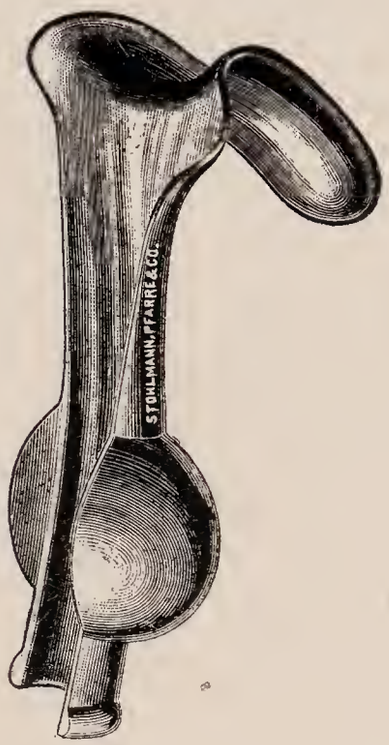


FIG. 108 —Garrigues' weighted speculum.



FIG. 109.—Vaginal spatula, with author's cervix-elevating attachment. *a*, under surface; *b*, upper surface.



FIG. 110.—Ferguson's cylindrical vaginal speculum.

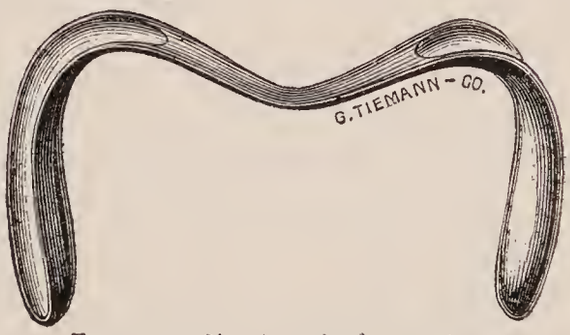


FIG. 111.—Sims' vaginal speculum.

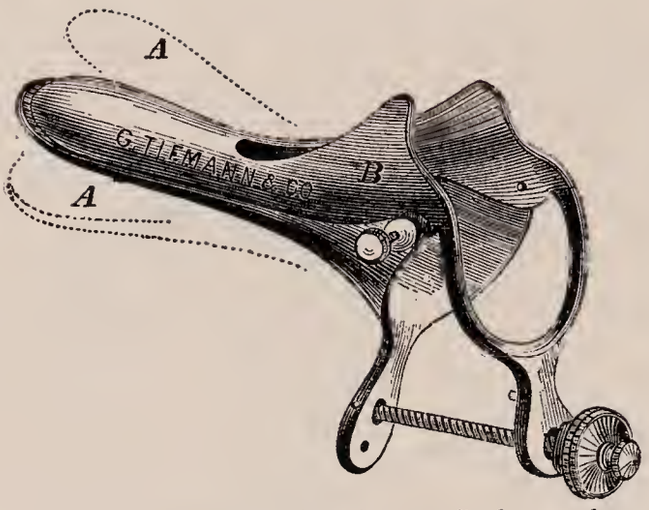


FIG. 112.—Brewer's bivalve vaginal speculum. *A*, open; *B*, closed.

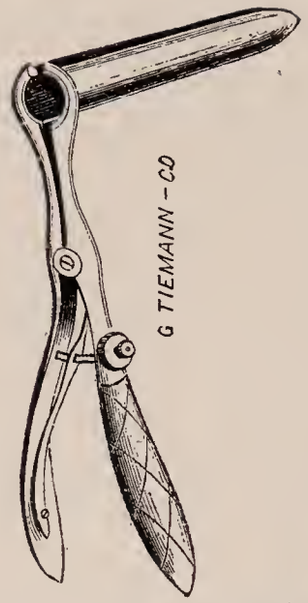


FIG. 113.—Bivalve rectal speculum.

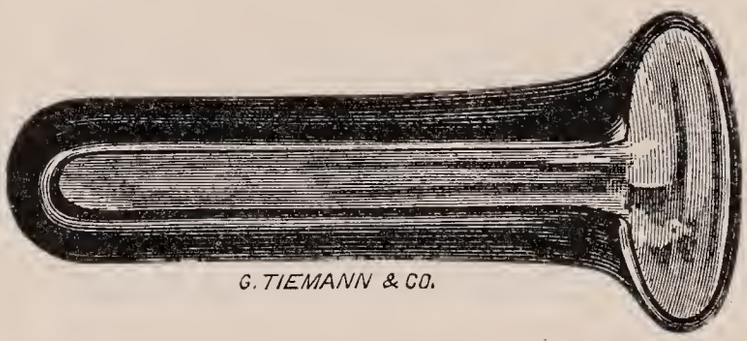


FIG. 114.—Ashton's fenestrated rectal speculum.

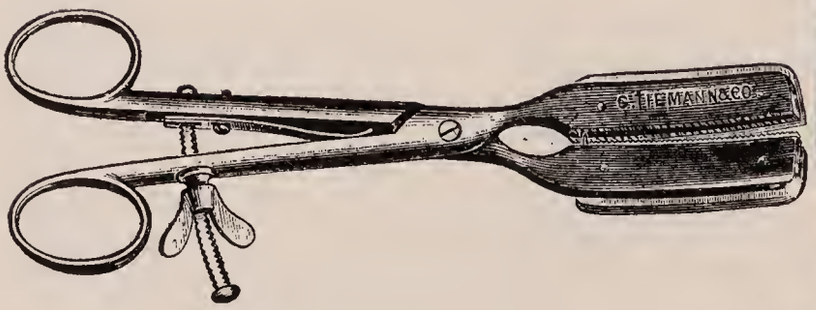


FIG. 115.—Smith's pile clamp.

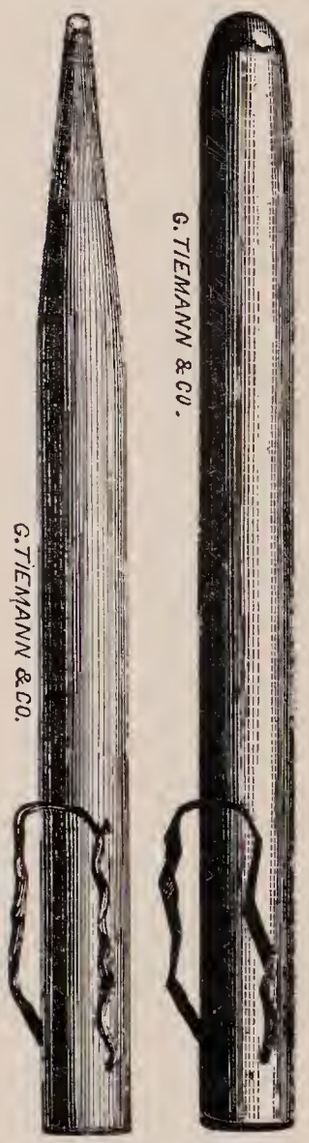


FIG. 116.—English rectal bougies.

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